INSTRUCTION MANUAL

for

PANORAMIC SPECTRUM ANALYZER MODELS SPA-3 & SPA-3/25 AND ACCESSORIES

Panoramic
INSTRUMENTS

Manufactured by

SINGER METRICS
DIVISION
THE SINGER MANUFACTURING COMPANY
915 PEMBROKE STREET • BRIDGEPORT 8, CONNECTICUT

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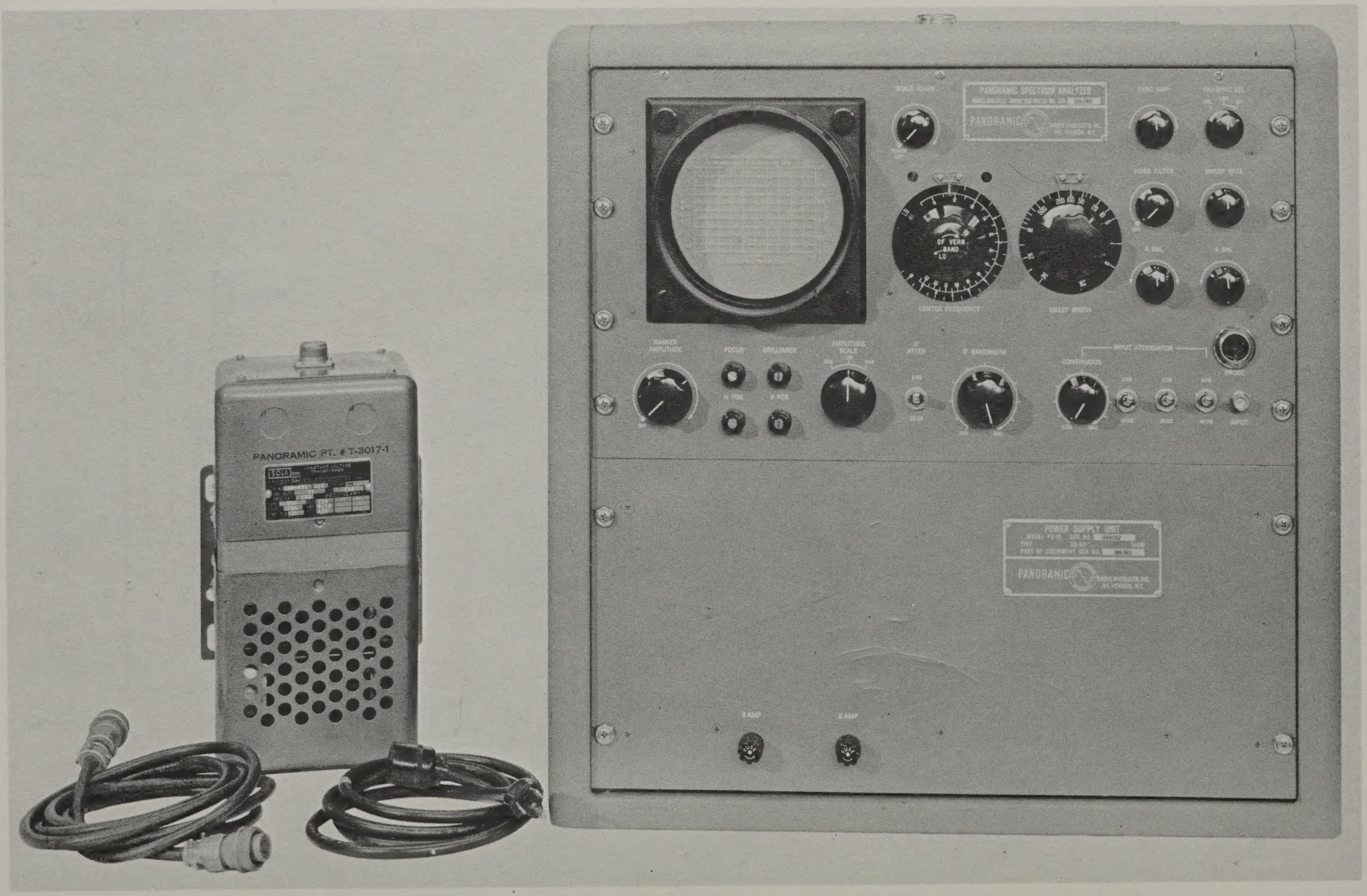
PANORAMIC PT. # T-3017-1
SOLA
CONSTANT VOLTAGE TRANSFORMER
SCALE ILLUM
PANORAMIC SPECTRUM ANALYZER
PANORAMIC
SYNC AMP
VIDEO FILTER
SWEEP RATE
X BAL
Y BAL
CF VERN
BAND
LO
CENTER FREQUENCY
SWEEP WIDTH
MARKER AMPLITUDE
FOCUS
BRILLIANCE
H POS
V POS
AMPLITUDE SCALE
IF ATTEN
IF BANDWIDTH
INPUT ATTENUATOR
CONTINUOUS
PROBE
INPUT
POWER SUPPLY UNIT
PANORAMIC
3 AMP
3 AMP

Figure I-1. Panoramic Spectrum Analyzer, Model SPA-3/25

ADDENDUM

Panoramic
Models SPA-3a and SPA-3/25a SPECTRUM ANALYZER

I. PURPOSE:

A. The purpose of this addendum is to provide technical data for Panoramic SPECTRUM ANALYZER, Models SPA-3a and SPA-3/25a by up-dating the present Instruction Manual for Panoramic Models.

II. CHANGE:

A. This change consists of revising the contents in the instruction manual and shall be accomplished as follows:

1. Add the suffix letter "a" to SPA-3 and SPA-3/25 Spectrum Analyzer throughout the instruction manual. Change all markers from "Panoramic Electronics, Inc." to "The Singer Company, Metrics Division."

2. Page 5, paragraph I-5c, delete the last sentence: "The Center Frequency Vernier is not calibrated."

3. Page 5, paragraph I-5e, change "2" volts to "1.4" volts (two places within paragraph). Change "20" uv to "25" uv, and change "200" uv to "250" uv.

4. Page 6, paragraph I-5g, change "50%" to "30%."

5. Page 6, paragraph I-5k, delete "are provided" and substitute "and 50 KC and its harmonics are provided."

6. Page 6, paragraph I-7a, for V101 change tube type "6BQ7A" to "6922." On page 9, after V123, add "V124, 6AH6, 500-KC-Marker Crystal Oscillator." Delete "V116, OA2, Voltage Regulator for Sweeping-Oscillator Section." For V115, change "A: 500-KC-Marker Crystal Oscillator" to "A: 50-KC-Marker Oscillator" and change "B: Marker-Output Cathode Follower" to "B: Marker Harmonic Generator."

7. Page 10, paragraph I-8e, change "50%" to "30%."

8. Page 12, under paragraph II-4a, add "SWEEP WIDTH Range Selector ... Wide"; change "IF ATTENuator ... 20 DB" to "15 DB"; and delete "AMPLITUDE" from "MARKER AMPLITUDE."

9. Page 15, paragraph II-4f, change "Center Frequency VERNier" to "ZERO ADJUST CONTROL." Change "20" DB to "15" DB.

10. Page 15, under paragraph II-4g, add "MARKERS --------- 500 KC."

11. Page 15, paragraph II-4g, delete the first sentence: "Switch the internal markers on by rotating the MARKER AMPLITUDE control clockwise." Modify the second sentence to read as follows: "Adjust the 'MARKER LEVEL' control for a convenient height of marker presentation."

12. Page 15, paragraph II-4h, change "AMPLITUDE" to "LEVEL."

13. Page 15, paragraph II-4i, modify the first two sentences to read: "Using the 500-KC marker pips, check the SWEEP WIDTH dial calibrations corresponding to frequencies above 0.5 mc. Adjust MARKER LEVEL Control for a convenient amplitude of marker display."

14. Page 17, paragraph II-4i, add to paragraph i. the following sentence: "Using the 50-KC marker pips (set MARKER frequency selector to 50 KC position), check the SWEEP WIDTH dial calibrations in increments of 0.05 mc between 0.05 mc and 0.5 mc."

15. Page 17, paragraph II-4i, second paragraph, delete the first sentence: "To check sweep widths narrower than 0.5 mc, an amplitude-modulated signal may be used."

16. Page 17, paragraph II-4j, change "Center Frequency VERNier" to "ZERO ADJUST Control."

17. Page 18, delete the second paragraph of paragraph II-4k, and substitute the following paragraph:

"A signal input amplitude of approximately 25 microvolts should result in a full-scale pip. Adjust generator level if necessary for a full-scale pip. Change the INPUT ATTENUATOR, STEP to 20 DB. The signal input amplitude required for full-scale deflection should be approximately 250 microvolts. Set INPUT ATTENUATOR, STEP to 40 DB, 60 DB, and then 80 DB. The signal input amplitude required for a full-scale deflection should be approximately 2.5 millivolts, 25 millivolts, and 250 millivolts, respectively. With IF ATTENuator at 15 DB and INPUT ATTENUATOR, STEP at 80 DB, an approximately 1.4 volt input should result in a full-scale deflection. Return INPUT ATTENUATOR, STEP to 40 DB and IF ATTENuator to 0 DB. Reduce input amplitude to approximately 2.5 millivolts to obtain a full-scale pip. Increase input amplitude to 25 millivolts and rotate INPUT ATTENuator, CONTINUOUS completely clockwise. The pip should be less than full scale, indicating more than a 20-db range in this control. Return INPUT ATTENUATOR, CONTINUOUS to the full counterclockwise position and adjust the input amplitude for a full-scale pip."

18. Page 18, third paragraph of paragraph II-4k, add the following sentence after the fourth sentence immediately following "...full scale": "Intermediate amplitude calibration points on the CRT screen for the LOGarithmic position of AMPLITUDE SCALE may be checked using the I.F. ATTENuator and INPUT ATTENuator in 5 DB steps." In the last sentence of the third paragraph of paragraph II-4k, delete the words "both," "and," and "LOGarithmic."

✓19. Page 19, paragraph III-1a, add the following to the second sentence: "...in two ranges." Add the following new paragraph prior to paragraph "b. CENTER FREQUENCY":

"a.1. SWEEP WIDTH Range Selector.

This Control is used to select the desired sweep width range. The ranges are 0 to 3 mc in the Wide position, and 0 to 100 KC in the Narrow position."

20. Page 19, paragraph III-1c, change heading from "CENTER FREQUENCY VERNIER" to "ZERO ADJUST (and BAND SELECTOR for SPA-3/25a)."

21. Page 19, after paragraph III-1c, add the following paragraph:

"c.1. FINE CENTER FREQUENCY.

"This control is used as a fine tuning control for variations in the order of 20 KC or less."

22. Page 20, paragraph III-1j, delete paragraph j. and substitute the following paragraph:

"For any given setting of the INPUT ATTENUATOR controls, this control provides attenuation of 15 DB in 5 DB increments. The 5 DB, 10 DB, and 15 DB positions should be used only when the AMPLITUDE scale is on LINear or PWR (power). When on LOGarithmic, the IF ATTENUATOR must be set on 0 DB to avoid inadvertent overload."

23. Page 20, paragraph III-1k, delete paragraph k. and substitute the following paragraph:

"This is a concentric control. It provides a choice of frequency and level as follows:

"1. The larger knob provides a means for turning the crystal controlled markers on and selecting either 50 KC or 500 KC and their harmonics.

"2. The smaller knob is used to adjust the marker level."

24. Page 20, paragraph III-2, add the following new paragraph:

"h. CALibration.

"This control is used to set the range of the CENTER FREQUENCY dial."

25. Page 21, paragraph III-3c, change "Center Frequency VERNier" to "ZERO ADJUST CONTROL" (two places within paragraph).

26. Page 21, paragraph III-3d, delete the second sentence of paragraph d. and add "Set marker frequency selector switch to the 500 KC position. Adjust the marker level control for a convenient height of marker presentation."

27. Page 22, change the bottom block in the chart to read as follows:

"(LOGarithmic position of AMPLITUDE
SCALE may only be used when IF ATTENuator is set to 0 DB.)"

28. Page 23, paragraph III-4b(5), change "CF VERNier" to "ZERO ADJUST CONTROL." Change "Center Frequency VERNier" to "ZERO ADJUST." Change "fine" to "coarse."

29. Page 26, paragraph III-4c(2), change "C(enter) F(requency) VERN(ier)" to "ZERO ADJUST." In the paragraph below III-4c(2), delete "(500 KC and its harmonics."

30. Page 36, delete paragraph IV-2b, and substitute the following paragraph:

"b. FREQUENCY MARKERS.

"The frequency markers consist of a 50 KC and a 500 KC signal and their harmonics.

"The 500 KC signal is generated by a crystal oscillator (V124).

"The 50 KC oscillator (V115A) is locked to a subharmonic of the crystal frequency. Both oscillator outputs are coupled to a diode connected tube (V115B) in order to produce rich harmonics.

"The MARKER LEVEL control (R337) forms the cathode resistor of the harmonic generator.

"The marker output is coupled to the grid of one section of the input cascode amplifier (V101)."

✓31. Page 36, paragraph IV-2c, modify the last sentence at the end of the third paragraph as follows: "A variable capacitor (C267) which is in parallel with one section of the CENTER FREQUENCY control serves as a means for calibrating the center frequency dial and also can be used as a tuning control for variations in the order of 200 KC or less."

32. Page 36, paragraph IV-2c, between the fourth and fifth paragraphs add the following paragraph:

"The SPA-3a has a Wide and Narrow SWEEP WIDTH range selector. In the Narrow range position, L128 is switched across the signal winding of L127. This parallel combination is placed in series with L129. The change in inductance of the tuning inductor (maintaining a constant sweep width voltage) now, causes a much smaller change in the total circuit inductance. The center frequency range of the sweeping oscillator in the Narrow range position is set with L129 and C264. Variable inductance L129 is used to set the zero-frequency end of the CENTER FREQUENCY dial. The OSC trimmer (C264) is used to set the high end of the dial."

33. Page 36, paragraph IV-2c, delete the fifth paragraph and substitute the following paragraph:

"The center-frequency range of the sweeping oscillator is set with L129 and C263 (the CALibration trimmer). Variable inductance L129 is used to set the zero-frequency end of the CENTER FREQUENCY dial. The CALibration trimmer is used to set the high-frequency end of the dial on the LO BAND on the SPA-3/25a."

34. Page 36, paragraph IV-2c, delete the eighth paragraph and substitute the following paragraph:

"To provide a stable B+ voltage for the sawtooth amplifier, V117, a zener diode, CR103, is used."

✓35. Page 37, Figure IV-1, revise block diagram of Analyzer Section as shown.

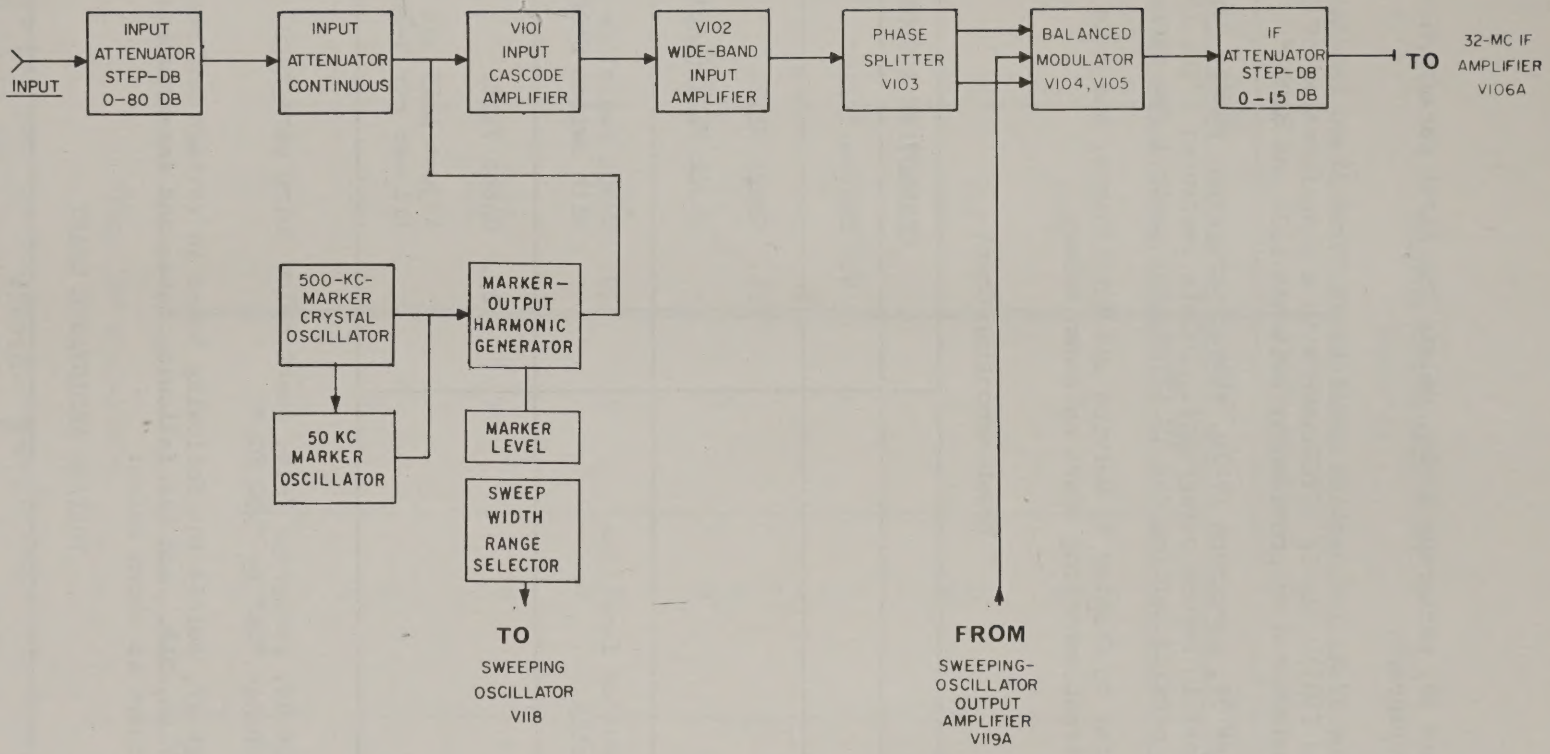
INPUT
INPUT ATTENUATOR STEP-DB 0-80 DB
INPUT ATTENUATOR CONTINUOUS
V101 INPUT CASCODE AMPLIFIER
V102 WIDE-BAND INPUT AMPLIFIER
PHASE SPLITTER V103
BALANCED MODULATOR V104, V105
IF ATTENUATOR STEP-DB 0-15 DB
TO 32-MC IF AMPLIFIER V106A
500-KC-MARKER CRYSTAL OSCILLATOR
50 KC MARKER OSCILLATOR
MARKER-OUTPUT HARMONIC GENERATOR
MARKER LEVEL
SWEEP WIDTH RANGE SELECTOR
TO SWEEPING OSCILLATOR V118
FROM SWEEPING-OSCILLATOR OUTPUT AMPLIFIER V119A

Figure IV-1. Partial Block Diagram - Revised

36. Page 39, paragraph IV-2e, delete the first paragraph and substitute the following paragraph:

"The 32-mc i-f section consists of three 32-mc bandpass filters (T101, T102, and T103). An IF ATTENuator with a step function of 15 DB of attenuation in 5 DB increments is provided by switches S102 and S109."

37. Page 39, paragraph IV-2e, second paragraph, change "or 20" to "to 15" db (two places in second paragraph). Delete sentence: "The IF ATTEN ADJUST chassis control permits setting the IF ATTENuator control for correct attenuation."

38. Refer to Chapter V, Service and Maintenance, and make the following changes in the troubleshooting chart as shown below:

Troubleshooting Chart

SYMPTOM	CORRECTIVE ACTION
	8. Delete "V116"
	11. Check V115. Check V124 (including Y104)
19. IF ATTENuator functions incorrectly	19. Check resistors associated with switch S102 and S109.
	23. Check V118. Adjust L129 and CALibration trimmer per V-2b(6).

39. Page 46, paragraph V-1b, chart below third paragraph, change "20" DB to "15" DB and change "ON" to "500 KC."

40. Page 47, delete the following tubes in voltage and resistance chart: V101, 6BQ7 and V116, OA2. Add the following tubes and measurements to the voltage and resistance chart as shown below:

VOLTAGE RESISTANCE CHART

Circuit Ref. Symbol	V101		Circuit Ref. Symbol	V124	
Type	6922		Type	6AH6	
Pin No.			Pin No.		
1	V	112	1	V	-5.2
	R	55K		R	52K

VOLTAGE RESISTANCE CHART
(cont'd)

Circuit Ref. Symbol	V101		Circuit Ref. Symbol	V124	
Type	6922		Type	6AH6	
Pin No.			Pin No.		
2	V R	0 100K	2	V R	0 0
3	V R	2.3 220	3	V R	5.2 VAC *
4	V R	5.2 VAC *	4	V R	0 0
5	V R	0 0	5	V R	160 24K
6	V R	190 15K	6	V R	132 48K
7	V R	112 54K	7	V R	0 .2
8	V R	112 55K	8	V R	
9	V R	0 0	9	V R	

*Very low resistance.

41. Page 49, make the following change in Table V-1, Stage Gain Chart: Change "6BQ7" (V101) to "6922."

42. Pages 49 and 50, paragraph V-2a, in the Analyzer Section Chart, delete "V116, OA2, None," and add the following within the chart:

ANALYZER SECTION

Reference Symbol	Tube Type	Required Procedure
V101	6922	Reset IF GAIN.
V115	12AX7	Reset T108 if required.
V118	6BK7	Check SWEEP WIDTH and CENTER FREQUENCY dial calibrations. Reset CALibration trimmer C263, C264, and L129 if required.
V124	6AH6	None

43. Page 50, paragraph V-2b(3), second paragraph, change the second sentence to read as follows: "Set SWEEP WIDTH to 3 mc, SWEEP WIDTH range selector to Wide (SPA-3a), and CENTER FREQUENCY for a centered 2 mc pip."

44. Page 51, paragraph V-2b(5), change the first sentence to read as follows: "With the SPA-3a, if the sweep width is not 3 mc when the SWEEP WIDTH dial is set for 3 mc (SWEEP WIDTH range selector in Wide position), reset the SWEEP LIMIT control."

45. Page 51, paragraph V-2b(6), change heading from "OSC TRIMMER (C263), L129," to "CALibration Trimmer (C263), L129." Change "Center Frequency VERNier" to "ZERO ADJUST Control" (two places within paragraph (6)).

46. Page 51, paragraph V-3, delete paragraph "a."

47. Page 52, paragraph V-3r, change "OSC TRIMMER" to "CALibration Trimmer." Delete the first sentence in paragraph r. and change to read as follows: "Variable capacitor C263 is used in conjunction with L129 on the SPA-3/25a to set the range of the CENTER FREQUENCY control."

48. Page 52, add the following paragraph:

"V-3r. C264 (SPA-3a).

"This variable capacitor is used in conjunction with L129 to set the range of the CENTER FREQUENCY control when the SWEEP WIDTH range selector is in the Narrow position."

49. Page 52, delete paragraph V-3v, and substitute the following paragraph:

"V-3v. L129 (SPA-3/25a).

"This variable inductance is used in conjunction with the CALibration trimmer (C263) to set the range of the CENTER FREQUENCY control."

50. Page 53, paragraph V-4a(3)(c), delete the first three sentences and substitute the following sentences:

"(c) Set CENTER FREQUENCY to 10 mc, SWEEP WIDTH to 3 mc (SWEEP WIDTH range selector to Wide), IF ATTENUATOR to 0 DB, and AMPLITUDE SCALE to LINEAR. Set MARKER frequency switch to 500 KC. Adjust the MARKER LEVEL CONTROL for a convenient height of marker presentation."

51. Page 54, paragraph V-4c(1), add the following to the first sentence: "(SWEEP WIDTH range selector to Wide (SPA-3a))."

52. Page 54, delete paragraph V-4c(4) and substitute the following paragraph:

"(4) Tune L109 for maximum pip deflection. If pip should disappear (oscillator quits) before or at maximum height, back up on tuning slug until pip reappears. If, at maximum pip deflection, tuning becomes critical (pip tends to disappear), back up on tuning slug until pip height is reduced by 10% of full scale."

53. Page 55, delete paragraph V-4d(1) through V-4d(9), and substitute the following paragraphs:

"d. OSCILLATOR ALIGNMENT.

"(1) SPA-3/25a.

"(a) Adjust the BIAS control R353 located on the oscillator chassis for 0.95 volts d-c as measured at the BIAS TEST jack on top of the oscillator chassis.

"(b) Set CALibration trimmer to center of its range.

"(c) If the gear coupling between the center frequency capacitor and sweep width track potentiometer has been disturbed*, proceed as follows: With the power off, remove fiducial, knobs, and CENTER FREQUENCY dial plate. Disconnect all cables from oscillator. Remove oscillator chassis. Tighten set screws on capacitor drive gear. Loosen set screws on sweep width track pot gear. Turn sweep width track pot to the maximum counterclockwise position. Turn the CENTER FREQUENCY capacitor counterclockwise until the plates are fully meshed. Then turn the capacitor about 5 degrees further. Tighten set screws on sweep width track pot gear. Turn power on, set SWEEP WIDTH to 3 mc.** (SWEEP WIDTH Range selector to Wide for SPA-3a.) Turn CENTER FREQUENCY control counterclockwise and note how far the zero-frequency pip moves to the right before it reverses direction. The travel to the right should be for one horizontal screen division. If it is not, turn power off and reset center frequency capacitor. If the travel is greater than one division, turn the capacitor slightly clockwise. If it is less, turn the capacitor slightly counterclockwise. Install oscillator chassis, CENTER FREQUENCY dial plate, fiducial and knobs. Attach all cables. Repeat Step (a).

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*This will happen only if the gearing associated with the CENTER FREQUENCY control loosens.

**Attach all cables to oscillator.

"(d) Turn CENTER FREQUENCY dial to 0. Set ZERO ADJ control on low band and to center of its range. Set the SWEEP WIDTH dial to 0.5 mc. Adjust L129 (on top of oscillator sub-chassis) so that zero frequency pip is in the center of the screen.

"(e) Connect a 10.5 mc signal to the analyzer input. Turn CENTER FREQUENCY dial to 10.5 mc. Adjust CALibration trimmer C263, located on the front panel, so that the 10.5 mc pip is in center of the screen.

"(f) Repeat steps (d) and (e) until "0" and "10.5" on SPA-3/25a is calibrated correctly.

"(g) Connect a 23.5 mc signal to the SPA-3/25a input. Set the CENTER FREQUENCY dial to 23.5 mc. (Be sure the equipment is set for the HI BAND.) If necessary, change the value of C270 such that the 23.5 mc pip is in the center of the screen.

"(h) The CENTER FREQUENCY dial calibrations can be checked by using the external markers. Refer to paragraph II-4j. Set the MARKER frequency selector to the 500 KC position. Adjust the MARKER LEVEL control for a convenient height of marker presentations. If required, construct an error chart for the dial or calibrate a new dial.

"(i) With the SWEEP WIDTH dial set to 3 mc, center a 2 mc pip on the screen. Using the markers as an indication, set the SWEEP WIDTH LIMIT control so that the sweep is 3 mc. The sweep is 3 mc when the third marker pip to the left and to the right of the 2 mc pip are within ± ½ division from the left and right edge of the calibrated crt screen rectangle. If the equipment is an SPA-3/25a, after the SWEEP WIDTH LIMIT control is set on the center frequency LO BAND, set R342 for 3 mc sweep width at a 10.5 mc center frequency (HI BAND).

"(j) Check the SWEEP WIDTH dial calibrations per paragraph II-4i. If required, construct an error chart for the dial or calibrate a new dial."

"(2) SPA-3a.

"(a) Repeat paragraph V-4d(1)(a).

"(b) Repeat paragraph V-4d(1)(b).

"(c) Repeat paragraph V-4d(1)(c).

"(d) Set ZERO ADJ control to Center of its range.

"(e) Connect a 13.5 mc signal to the analyzer input. Turn the CENTER FREQUENCY dial to 13.5 mc. Adjust the CALibration trimmer so that the 13.5 mc pip is in the center of the screen.

"(f) Turn CENTER FREQUENCY dial to "0". The zero frequency pip should appear in the center of the screen. If necessary, adjust R353, BIAS control, measured at the BIAS TEST JACK. Note: Bias voltage shall be 0.95 V ± 0.1 V.

"(g) Repeat steps (e) and (f) until "0" and "13.5" on the frequency dial are calibrated correctly.

"(h) Check and adjust, if necessary, the SWEEP WIDTH dial as directed in step V-4d(1)(i).

"(i) Set SWEEP WIDTH dial to 3 mc. Set SWEEP WIDTH range selector to Wide. Turn CENTER FREQUENCY dial to "0." The zero frequency pip should appear in the Center of the screen.

"(j) Set SWEEP WIDTH range selector to Narrow. Zero frequency pip should appear on the screen. If necessary, adjust L129. Note: pip will appear wider in the Narrow position because of reduced sweep width.

"(k) Set SWEEP WIDTH range selector to Wide. Turn CENTER FREQUENCY dial until 13.5 mc pip appears in the center of the screen. Set SWEEP WIDTH range selector to Narrow. Pip should still appear on the screen. If necessary, adjust C264.

"(l) Repeat steps (j) and (k) until the "0" and "13.5" mc pips remain on the screen when switching from Wide to Narrow sweep widths."

54. Page 55, paragraphs V-4e(1) and V-4e(2), change "20 uv" and "20 uf" to "25 uv" (total of three places).

55. Page 57, delete paragraphs V-4g(1), (2), (3), and (4).

56. Page 57, paragraph V-5d, first paragraph, change "20 DB" to "15 DB." In the second paragraph, change "20 DB" and "9.8 to 10.2 times" to "15 DB" and "5.4 to 5.8 times," respectively.

57. Page 58, paragraph V-5g, first paragraph, delete the fourth and fifth sentences and substitute the following: "Switch the internal markers on by rotating the MARKER frequency control 500 KC. Adjust the MARKER LEVEL control for a convenient height of marker presentation." In the second paragraph of V-5g, change "Center Frequency VERNier" to "ADJUST Control."

58. Page 58, delete both paragraphs of V-5h and add, "Repeat paragraph II-4i."

59. Page 59, paragraph V-5k(1), table for control settings, change "20 DB" to "0 DB" (two places within table). Delete the second paragraph of V-5k(1) and substitute the following paragraph:

"Adjust the generator level for a full-scale crt deflection. Switch AMPLITUDE SCALE to LOGarithmic. The pip amplitude should be in line with the 20 DB calibration dot on the left side of the calibrated crt scale. Change INPUT ATTENuator, STEP to 0 DB. Pip amplitude will again increase to full scale. Intermediate amplitude calibration points on the crt screen for the LOGarithmic position of AMPLITUDE SCALE may be checked using the IF ATTENuator and INPUT ATTENuator in 5 DB steps. Intermediate amplitude calibration points on the crt screen for the LINear position of AMPLITUDE SCALE may be checked against known input levels."

60. Page 61, paragraph VI-1(b), second table, change voltage of "Probe less attenuator head" from "1 volt" to "0.1 volt."

III. LIST OF REPLACEABLE PARTS

A. Pages 65 through 103, paragraph VII-2, delete the following parts from the "List of Replaceable Parts" referring to the Circuit Ref. Symbols:

C103, C105, C111, C135, C153, C162, C197, C199, C209, C235, C237, C238, C239, C240, C241, C243, C247, C251, C255, C257, C262, C263, C265, C267, C331, C333, C335, C337, C501, L121, L123, L127, L129, L130, L131, L133, L135, L141, L143, L145, L147, P117, R502, R121, R127, R135, R138, R144, R146, R167, R169, R181, R263, R331, R333, R335, R337, R339, R341, R342, R343, R344, R349, R351, R417, R423, R448, R469, S102, S103, S104, S105, S106, V101, V110, and V116.

B. Pages 65 through 103, paragraph VII-2, add the following parts to the "List of Replaceable Parts":

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 1 yr. Opn.	Unit Price
C103		CAPACITOR: fixed, electrolytic, 10 uf, 15V Pan Part CE71X100E-1		2		
C104		Same as C103				
C111		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0	16		
C130		CAPACITOR: fixed, electrolytic, tubular, 4 uf, 350 V Singer #556074-028				
C153		CAPACITOR: fixed, silvered mica, 10 uuf, ±5%, 300 V Pan Part CM15C100J	AL CM15C100J	1		
C162		CAPACITOR: fixed, ceramic feed thru, 1000 uuf, ±20%, 500 V Pan Part CC2138-13	AM GP(SL) 327-1000			
C197		CAPACITOR: fixed, silvered mica, 47 uuf, 5%, 300 V Pan Part CM15C470J	AL CM15C470J	1		
C199		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%, 300 V Pan Part CM15C101J	AL CM15C101J	1		
C209		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%, 500 V Pan Part CM20C101J	AL CM20C101J	5		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 1 yr. Opn.	Unit Price
C235		CAPACITOR: fixed, silvered mica, .75 uuf, ±5%, 300 V Pan Part CM15C750J	AL CM15C750J			
C237		CAPACITOR: fixed, silvered mica, 5100 uuf, ±5%, 500 V Pan Part CM30B512J	AL CM30B512J			
C239		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z			
C241		CAPACITOR: fixed, silvered mica, 2700 uuf, ±5%, 500 V Pan Part CM30C272J	AL CM30C272J	1		
C242		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%, 300 V Pan Part CM15E471J	AL CM15E272J	1		
C247		CAPACITOR: fixed, silvered mica, 2200 uuf, ±5%, 500 V Pan Part CM30E222J				
C251		Same as C247				
C255		CAPACITOR: fixed, silvered mica, 180 uuf, ±5%, 300 V Pan Part CM15E181J				
C257		Same as C111				
C262		CAPACITOR: fixed, silvered mica, 330 uuf, ±5%, 300 V Pan Part CM15C331J				
C263		CAPACITOR: variable air dual, trimmer section Pan Part CV2282				
C264	SPA-3a	CAPACITOR: variable, ceramic NPO trimmer, 1.5 to 7 uuf Pan Part CV2140J-14	AF 822-E2	1		
C265	SPA-3a	CAPACITOR: dual, variable, air dielectric, 8.3 - 81 uuf each section Pan Part CV2285				

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 1 yr. Opn.	Unit Price
C265 A,B	SPA-3/25a	CAPACITOR: dual, variable, air dielectric, 6.5 - 51 uuf Pan Part CV2002	AK 167-52	1		
C267	SPA-3/25a	CAPACITOR: adjustable, air trimmer, 3 - 6 uuf Singer #556168-084		1		
C267	SPA-3a	CAPACITOR: adjustable, air trimmer, 3 - 6 uuf Singer #556168-085		1		
C331		CAPACITOR: fixed, ceramic feed thru, 1000 uuf, ±20%, 500 V Pan Part CC2138-13	AM GP(SL) 327-1000			
C333		CAPACITOR: fixed, ceramic feed thru, 1000 uuf, ±20%, 500 V Pan Part CC2138-13	AM GP(SL) 327-1000			
C335		CAPACITOR: fixed, ceramic feed thru, 1000 uuf, ±20%, 500 V Pan Part CC2138-13	AM GP(SL) 327-1000			
C337		CAPACITOR: fixed, ceramic feed thru, 1000 uuf, ±20%, 500 V Pan Part CC2138-13	AM GP(SL) 327-1000			
C338		Same as C173				
C339		Same as C245				
C340		Same as C136				
C341		Same as C136				
C342		Same as C136				
C343		Same as C136				
C344		Same as C136				
C345		Same as C136				
C346		Same as C136				

Circuit Ref. Symbol	Stock No.	Description	Mfr. & In Set	Qty. In Set	Qty 1 yr. Opn.	Unit Price
C501*		CAPACITOR: fixed, silvered mica, 62 uuf, ±5%, 300 V, factory selected Pan Part CM15C620J	AL CM15C620J	1		
CR103		DIODE: Zener, 150 V, 10 W, ±20% Part #IN3011	BL IN3011			
L121		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A	10		
L123		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			
L127	SPA-3/25a	INDUCTOR: Vari-L Pan Part L2049A	AZ SD-36A	1		
L127	SPA-3a	INDUCTOR: Vari-L Pan Part L3028	AZ SD-360	1		
L128	SPA-3a	Same as L137				
L129	SPA-3a	COIL: oscillator, variable Pan Part ZN-8507				
L129	SPA-3/25a	COIL: oscillator, variable Pan Part ZN-8375	AT Z2-8375A	1		
L130		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			
L131		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			
L132		CHOKE: r-f Pan Part ZN-8495				
L133		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			
L134		CHOKE: r-f Pan Part ZN-8495				
L135		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			

*72 ohm input.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty 1 yr. Opn.	Unit Price
L141		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			
L143		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			
L145		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			
L147		CHOKE: r-f, 0.75 uh Pan Part L2039	AT Z1-10998A			
L149		Same as L119				
P117		CONNECTOR: plug, r-f Pan Part P2051	BK 8575	1		
P502		RECEPTACLE: BNC, Mil type, UG260/U Pan Part P2010	AB 31-012			
R121		RESISTOR: fixed, composition, 220 ohms, +5%, 1/2 W Pan Part RC20BY221J	AA EB2215			
R135		RESISTOR: fixed, composition, 200,000 ohms, +5%, 1/2 W Pan Part RC20BX204J	AA EB2045	1		
R138		RESISTOR: fixed, composition, 91 ohms, +5%, 1/2 W Pan Part RC20BX910J	AA EB9105			
R144		RESISTOR: fixed, composition, 15,000 ohms, +5%, 1 W Pan Part RC32BX153J	AA GB1535	1		
R152		RESISTOR: fixed, composition, 100 ohms, +5%, 1/2 W Singer #556033-094				
R154		RESISTOR: fixed, composition, 100 ohms, +5%, 1/2 W Singer #556033-094				
R167		RESISTOR: fixed, composition, 100,000 ohms, +5%, 1/2 W Pan Part RC32BX1045	AA GB1045	5		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty 1 yr. Opn.	Unit Price
R169		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225	5		
R178		RESISTOR: fixed, composition, nominal value 120 ohms, ±5%, 1/2 W Singer #556033-098				
R196		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX100J	AA EB1015			
R263		RESISTOR: fixed, composition, factory selected, 15,000 ohms, ±5%, 1 W, nominal value* Pan Part RC32BX153J	AA GB1535	1		
R331		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135	1		
R333		RESISTOR: fixed, composition, 22,000 ohms, ±5%, 1/2 W Pan Part RC20BX223J	AA EB2235			
R335		RESISTOR: fixed, composition, 27,000 ohms, ±5%,1/2 W Pan Part RC20BX273J	AA			
R337		RESISTOR: variable, composition, linear (part of S104), 1,000 ohms, ±10%, 2 W				
R339		RESISTOR: fixed, wirewound, radial leads, 2,000 ohms, ±10%, 10 W Pan Part RW10X252R-6	AY FRL-10			
R340		RESISTOR: fixed, wirewound, 7 K ohms, ±5%, 10 W Pan Part RW10X702R				

*For actual value, see schematic diagram.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty 1 yr. Opn.	Unit Price
R341	SPA-3a	RESISTOR: fixed, composition, factory selected, 150,000 ohms, ±5%, 1/2 W, nominal value* Pan Part RC20BX154J	AA EB1545			
R342	SPA-3/25a	RESISTOR: fixed, composition, factory selected, 47 K, ±5%, 1/2 W, nominal value* Pan Part RC20BX473J	AA EB4735			
R343	SPA-3/25a	RESISTOR: fixed, composition, factory selected, 120 K, ±5%, 1/2 W, nominal value* Pan Part RC20BX124J	AA EB1245	1		
R344	SPA-3/25a	RESISTOR: fixed, composition, factory selected, 180 K, ±5%, 1/2 W, nominal value* Pan Part RC20BX184J	AA EB184J			
R348		RESISTOR: fixed, composition, 4.7 K ohms, ±5%, 1/2 W Pan Part RC20BX472J				
R349	SPA-3a	RESISTOR: variable, composition, clockwise, log A taper (includes switch S 108), 100,000 ohms, ±10%, 2 W				
R349	SPA-3/25a	RESISTOR: variable, composition, clockwise, log A taper, 100,000 ohms, ±10%, 2 W Pan Part RV058	AT RV2-22058	1		
R350		RESISTOR: variable, composition, 10 K ohms, ±10%, 1/2 W Pan Part RVM412				
R351		RESISTOR: fixed, composition, 20,000 ohms, ±5%, 1/2 " Pan Part RC20BX203J				

*For actual value, see schematic diagram.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 1 yr. Opn.	Unit Price
R352		RESISTOR: fixed, composition, 129,000 ohms, ±5%, 1/2 W Pan Part RC20BX124J	AA EB1245	1		
R417		RESISTOR: variable, composition, linear, 2 megohms, ±20%, 2 W Pan Part RV017	AT RV2-22017	1		
R420		RESISTOR: fixed, composition, 510 K ohms, ±5%, 1/2 W Pan Part RC20BX514J				
R422		RESISTOR: fixed, composition, 910 K ohms, ±5%, 1/2 W Pan Part RC20BX914J				
R450		RESISTOR: fixed, composition, 178.7 ohms, ±1%, 1/2 W Pan Part RC20A2178P7F				
R469		RESISTOR: variable, wirewound, linear (includes switch S110), 6 ohms, ±10%, 2 W Pan Part RVS700	AT RV2-22700	1		
R470		RESISTOR: fixed, wirewound, radial leads, 10 K ohms, ±10%, 5 W Pan Part RW5X103R-1				
R471		RESISTOR: fixed, composition, 100 K ohms, ±5%, 1/2 W Pan Part RC20BX104J				
R472		RESISTOR: fixed, composition, 51 K ohms, ±5%, 1/2 W Singer #556033-081				
R475		RESISTOR: fixed, composition, 96.5 ohms, ±1%, 1/2 W Pan Part RC20A271P3F				

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 1 yr. Opn	Unit Price
R476		RESISTOR: fixed, composition, 71.3 ohms, ±1%, 1/2 W Pan Part RC20A271P3F				
R477		RESISTOR: fixed, composition, 96.5 ohms, ±1%, 1/2 W Pan Part RC20A271P3F				
R478		RESISTOR: fixed, composition, 178.7 ohms, ±1%, 1/2 W Pan Part RC20A2178P7F				
R479		RESISTOR: fixed, composition, 30.4 ohms, ±1%, 1/2 W Pan Part RC20A230P4F				
S102		SWITCH: toggle, DPDT bat handle Pan Part S2096	AC 83054	2		
S103		SWITCH: rotary, phenolic wafer, single section, 3 pole, 3 throw Pan Part S1-9395B	AT S1-9395B	2		
S104		SWITCH: concentric, rotary (see R337), phenolic wafer, single section, 2 pole, 3 throw Pan Part S2-14336	AT S2-14336	1		
S105		SWITCH: rotary, ceramic wafer, single section, 3 pole, 3 throw Pan Part S1-9395B	AT S1-9395B			
S106	SPA-3/25a	SWITCH: rotary, ceramic, 5 pole, 1 section, 2 section Pan Part S2-11714	AT S2-11714	1		
S108	SPA-3a	SWITCH: concentric, rotary, ceramic wafer, single section, 3 pole, 2 throw (see R349) Pan Part S2-14169A				
S109		Same as S102				

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty, In Set	Qty. 1 yr. Opn.	Unit Price
T107		TRANSFORMER: r-f, 500 KC Pan Part ZN-8504				
T108		TRANSFORMER: osc., 50 KC Pan Part ZN-8505				
V101		ELECTRON TUBE: 6922 Pan Part 6922	BA 6922	1		
V110		ELECTRON TUBE: 6CB6 Pan Part 6CB6A	BA 6CB6A	1		
V124		ELECTRON TUBE: 6AH6 Pan Part 6AH6	AT 6AH6			

C. Page 104, add the following to the Manufacturers Code for List of Replaceable Parts:

BK	Industrial Products
BL	International Rectifier Corp.

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CHAPTER I
INTRODUCTION

I-1. GENERAL

This Instruction Manual contains information concerning electrical and physical characteristics, applications, installation, and operation of the Panoramic Spectrum Analyzers, Models SPA-3 and SPA-3/25, as well as information concerning maintenance and servicing. Information also is provided for various accessory equipment which may be used with the spectrum analyzer.

No attempt to operate the equipment should be made until the user is thoroughly familiar with the information contained in Chapter III, OPERATING INSTRUCTIONS.

I-2. APPLICATIONS

The Panoramic Spectrum Analyzers, Models SPA-3 and SPA-3/25 (with associated power supply, Model PS-19) provide a simple, reliable method for analysis or monitoring of complex discrete signals and/or noise in the frequency region of 200 cps to 15 mc (to 25 mc with the Model SPA-3/25).

The equipment provides an automatic, visual presentation (on the screen of a long-persistence cathode-ray tube) of the frequency and amplitude of signals present in the frequency region of 200 cps to 15 mc (to 25 mc with the Model SPA-3/25) for such studies as harmonic content, cross-modulation products, filter and transmission-line checks, vibration measurement, and telemetry-channel monitoring.

The equipment can be used to display modulated signals (am, fm, pulse, or combinations) to measure energy distributions and to look for such effects as unwanted or excessive modulations, linearity of deviations, hum and noise, and otherwise undetectable parasitic oscillations. Other dynamic phenomena such as crowded communications channels, oscillator or carrier instability, and noise spectra can be studied. Both the direction and magnitude of changes caused by deliberate or random change of circuit or operating parameters, mechanical shocks, environmental changes, etc. can be seen instantly.

The designed versatility of the unit permits selection of center frequency, sweep width, sweep rate, intermediate-frequency bandwidth, and type of amplitude scale. The equipment enables the selection and detailed analysis of a narrow band which may contain signals separated by as little as 200 cps.

Once the norms for an application are established, nonprofessional personnel in the laboratory or factory easily can use the equipment to provide a graphic visualization of spectrum content. Yet the equipment is critically designed for laboratory investigations on the research and development levels.

In order to obtain a minute examination of modulated signals or groups of adjacent signals the SPA-3 can be conditioned readily to select for presentation any 0 to 3 mc band between 200 cps and 15 mc (between 200 cps and 25 mc with the SPA-3/25). This is particularly useful when the system usage involves modulated signals or closely-spaced signals since an expanded presentation of just those adjacent signals that are being analyzed can be obtained. A Panoramic display of the signals permits identification of unwanted effects at a glance thereby affording a quick appraisal of those above tolerable levels. Since such observations can be employed without resorting to special and more difficult instruments and procedures, routine signal inspection with the Panoramic Spectrum Analyzer will pinpoint difficulties and allow preventive action to be taken before important system failure is expensively revealed.

The scope and facility of measurement with the Panoramic Models SPA-3 and SPA-3/25 can be extended by using it in conjunction with certain compatible Panoramic and commercially available equipments.

- The amplitude-versus-frequency response of systems and devices can be determined in the frequency region between 200 cps and 15 mc using the accessory Panoramic Companion Sweep Generator, Model G-6.
- To facilitate comparison of two input signals (comparing two similar test signals; comparing a test signal to a standard, known signal; etc.), the Panoramic Signal Alternator, Model SW-1, can be used to alternate the two inputs to the spectrum analyzer.
- To drive auxiliary slave indicators, the equipment provides an auxiliary vertical output.

- To synchronize the Model SW-1, camera shutters, and/or auxiliary slave indicators, a pulse output is provided by the spectrum analyzer. This pulse output is in synchronism with the sweep of the spectrum analyzer.

- To permit aural monitoring at zero sweep width, detected output is available from the spectrum analyzer.

- To permit connection of signals from a high-impedance source, a special probe, Model PRB-1a, is required. This probe is supplied only if ordered.

- A Polaroid-type oscilloscope camera suitable for screen photography may be obtained from Panoramic Electronics, Inc. The SPA-3 and SPA-3/25 camera-mounting bezels are designed to accommodate this camera.

I-3. GENERAL DESCRIPTION

The Panoramic Spectrum Analyzer is a scanning heterodyne instrument. It automatically provides a visual, two-dimensional display of the frequency components of a complex wave, in any selected 0- to 3-mc segment of the region between 200 cps and 15 mc (25 mc with the SPA-3/25). The display appears on the screen of long-persistence, flat-faced, cathode-ray tube, as vertical deflections distributed horizontally in order of component frequency. The frequency presentation is linear. The height of a given vertical deflection indicates the relative magnitude of its corresponding frequency component.

The spectrum analyzer consists basically of a calibrated input attenuator, an input ~~cascode~~ cascade amplifier, a wide-band amplifier, a phase splitter, a sweeping oscillator, a balanced mixer, an intermediate-frequency-section attenuator, a 32-mc if amplifier, a 29.3-mc crystal oscillator, a second mixer, variably selective intermediate-frequency amplifiers (2.7 mc), a detector, vertical and horizontal deflection amplifiers, a sawtooth generator, and a cathode-ray-tube indicator.

The sweeping oscillator progressively heterodynes, in order of frequency, with those signals at the output of the phase splitter to produce, among the mixing products, a difference frequency which is applied to the 32-mc intermediate-frequency section. A balanced modulator is employed to eliminate spurious modulation products and prevent passage of the sweeping-oscillator frequency into the 32-mc i-f section. The output of the 32-mc i-f section is mixed with the output of the 29.3-mc crystal oscillator.

The 2.7-mc product of this mixing passes through a 2.7-mc variably selective i-f section. The output voltage of the 2.7-mc i-f section is proportional to the amplitude of the sampled portion of the input signal. This output is detected, amplified, and applied to the vertical deflection plates of the cathode-ray tube. The vertical deflection appears at a definite location along the horizontal axis according to signal frequency since a common sawtooth voltage source is used for both the sweeping oscillator and the horizontal deflection of the crt beam.

Oscillator sweep is obtained with a sawtooth-modulated circuit (consisting basically of a voltage-controlled tuning inductor) which controls the frequency of the oscillation. A calibrated SWEEP WIDTH control varies the amplitude of the modulating sawtooth to permit selection of any sweep width from 0 to 3 mc. A calibrated CENTER FREQUENCY control tunes the swept oscillator to permit selection of any center frequency between 0 and 13.5 mc (0 and 23.5 mc in the case of the SPA-3/25).

In order to satisfy a very broad application range, the equipment incorporates independent SWEEP WIDTH, IF BANDWIDTH, and SWEEP RATE controls. For example, there are cases where high probability of signal intercept is paramount. This requires short scan intervals, hence the variable SWEEP RATE control and an IF BANDWIDTH control to obtain a suitable intermediate-frequency section bandwidth for the selected scanning velocity (product of sweep width and sweep rate). In other instances, for statistical purposes it may be necessary to scan slowly yet maintain a broad intermediate-frequency section bandwidth.

Three different amplitude scales can be selected, a linear scale calibrated in 10 divisions, a logarithmic scale calibrated from 0 db to 40 db in 5-db divisions, and a power scale wherein an approximately 2 to 1 voltage ratio provides a 4 to 1 ratio of screen deflection. The power scale is particularly useful for evaluating power levels, half-power points, and for critical amplitude comparison between signals of similar amplitude.

The Models SPA-3 and SPA-3/25 and the companion power supply, Model PS-19, normally are supplied mounted in a common carrying case. However, when removed from the carrying case, the units can be mounted in a standard, 19-inch, electrical-equipment rack.

Screen observations and photography are facilitated by providing a flat-faced cathode-ray tube (type 5ADP7), edge lighting for the crt, and a camera mounting bezel. A Polaroid-type oscilloscope camera, specifically intended for use with the SPA-3 and SPA-3/25 mounting arrangements, can be purchased from Panoramic Electronics, Inc.

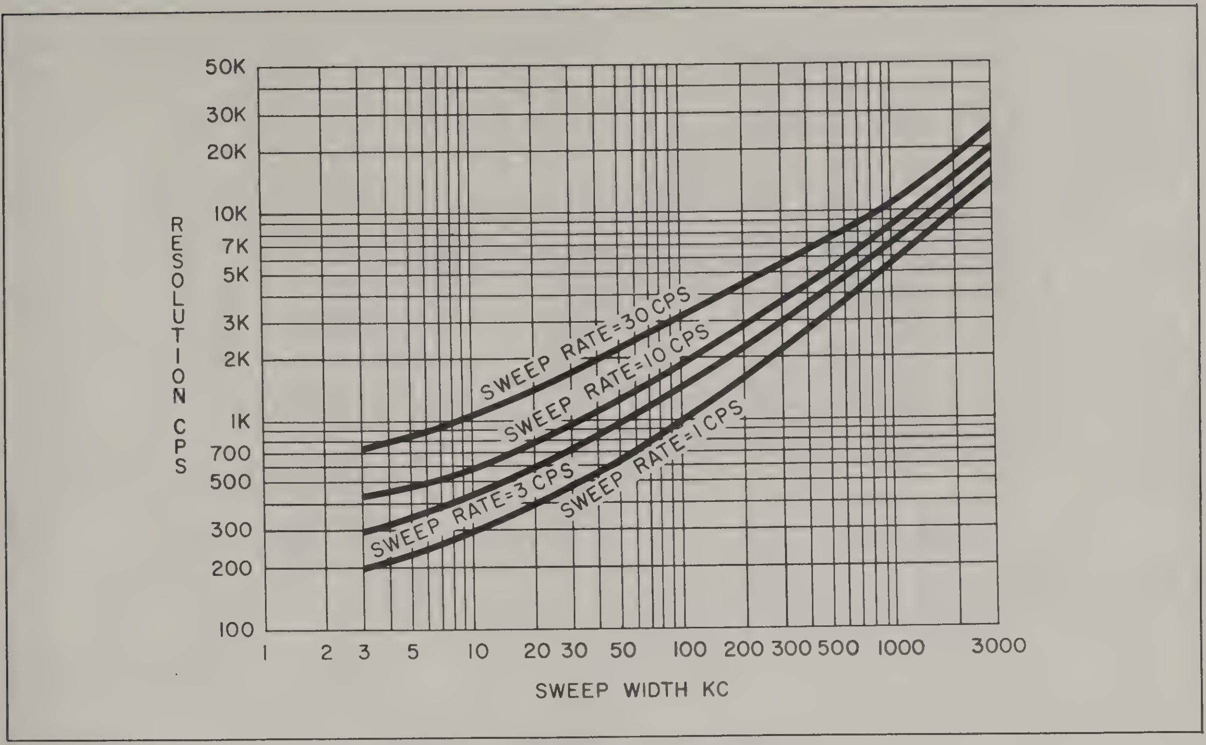

Figure I-2. Resolution Versus Sweep Width.

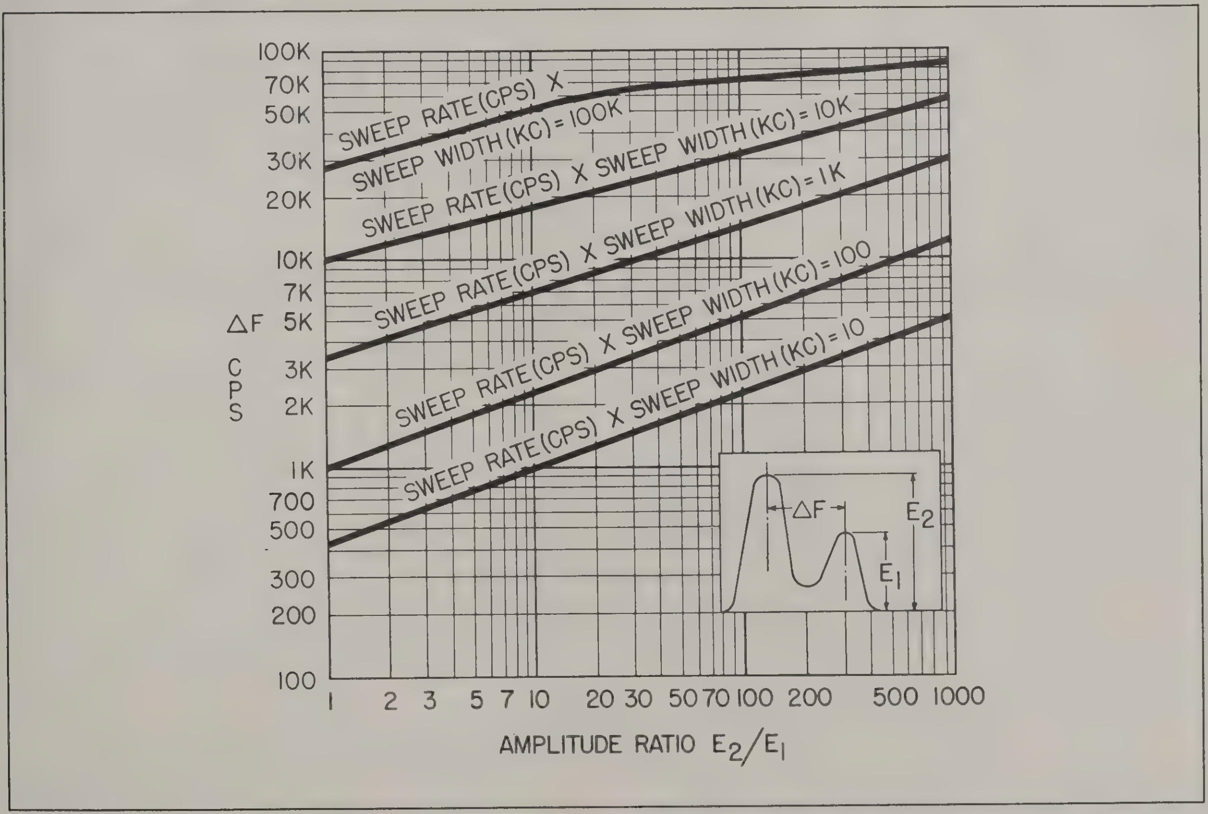

Figure I-3. Minimum Frequency Separation ΔF Required to Measure Amplitude Ratios E_2/E_1.

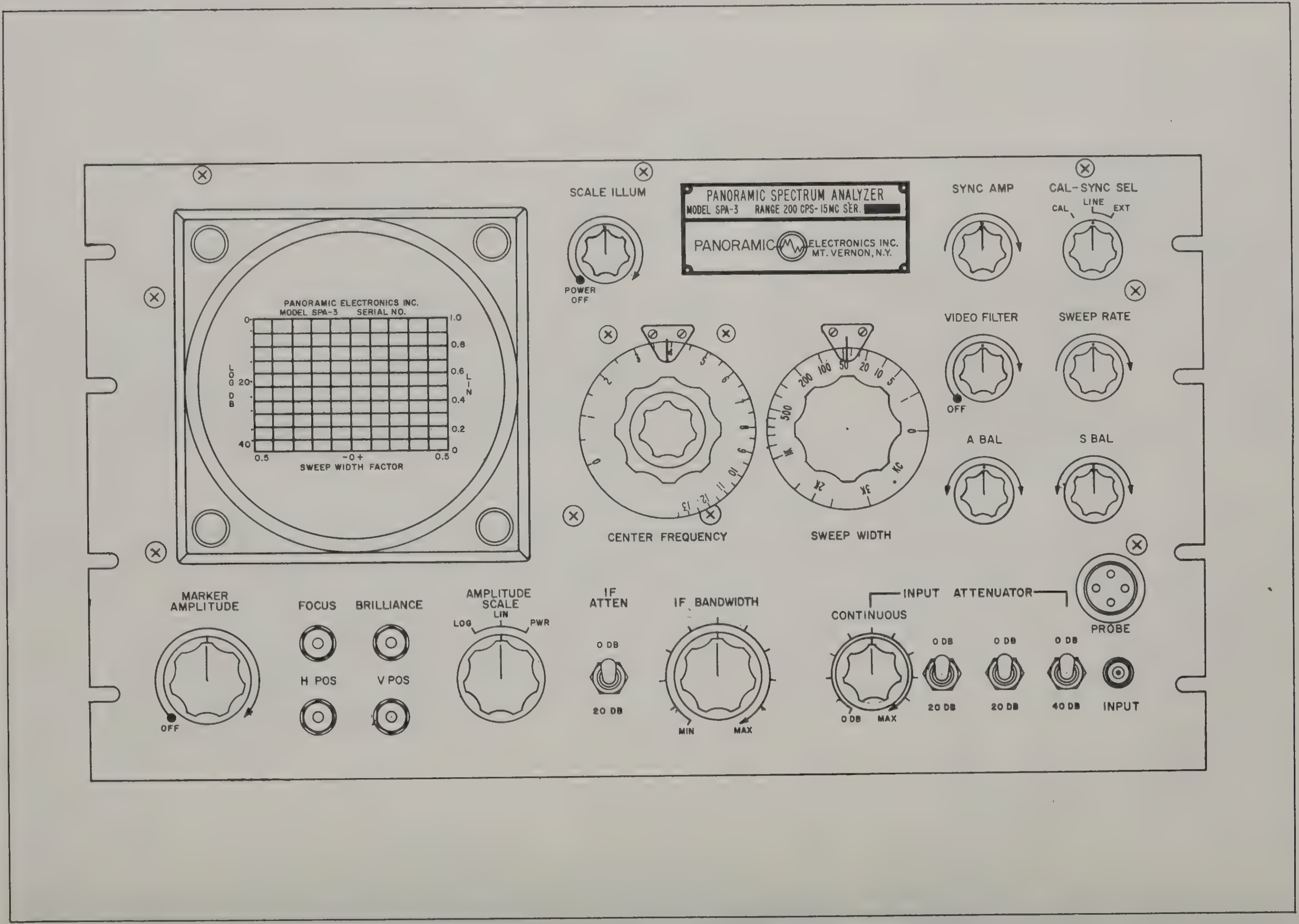
SCALE ILLUM
POWER OFF
PANORAMIC SPECTRUM ANALYZER
MODEL SPA-3 RANGE 200 CPS-15MC SER.
PANORAMIC ELECTRONICS INC. MT. VERNON, N.Y.
SYNC AMP
CAL-SYNC SEL
CAL
LINE
EXT
PANORAMIC ELECTRONICS INC.
MODEL SPA-3 SERIAL NO.
LOG DB
0
20
40
LIN
1.0
0.8
0.6
0.4
0.2
0
0.5
-0+
0.5
SWEEP WIDTH FACTOR
VIDEO FILTER
OFF
SWEEP RATE
CENTER FREQUENCY
SWEEP WIDTH
200
100
50
20
10
5
500
1K
2K
3K
KC
0
A BAL
S BAL
MARKER AMPLITUDE
OFF
FOCUS
BRILLIANCE
H POS
V POS
AMPLITUDE SCALE
LOG
LIN
PWR
IF ATTEN
0 DB
20 DB
IF BANDWIDTH
MIN
MAX
INPUT ATTENUATOR
CONTINUOUS
0 DB
MAX
0 DB
20 DB
0 DB
20 DB
0 DB
40 DB
PROBE
INPUT

Figure I-4. Front Panel, Model SPA-3 Analyzer Section.

The equipment normally is supplied for operation from a 95- to 130-volt, 60-cps single-phase power source. If so ordered, it can be supplied to operate from a 190- to 260-volt and/or 50-cps line.

I-4. EQUIPMENT SUPPLIED

Description	Quantity
Analyzer section of Panoramic Spectrum Analyzer, Model SPA-3 or SPA-3/25	1
Panoramic Power Supply, Model PS-19	1
Constant-Voltage Transformer, Panoramic No. T-3017-1	1
Interconnecting cable, power, 14 wire, SPA-3 or SPA-3/25 to PS-19, Panoramic No. W24-25P5	1
Interconnecting cable, power, 5 wire, PS-19 to CV Transformer, Panoramic No. W34-96	1
Line cord, ac, 3 wire (with adapter for 2-wire power line), Panoramic No. W4-72	1
Key for #4 multiple-spline socket screw	1*
Key for #6 4-point-spline socket screw	1*
Key for #8 multiple-spline socket screw	1*
Tool, Alignment, Walsco #2543	1*
Tool, Alignment, Cambridge Thermionic #X2033	1*
Spare Fuse, cartridge, 3 a, 250 v, Type 3 AG	2**

I-5. ELECTRICAL CHARACTERISTICS

a. FREQUENCY RANGE.

SPA-3: Any selected 0- to 3-mc portion of the range between 200 cps and 15 mc.

SPA-3/25: Any selected 0- to 3-mc portion of the range between 200 cps and 25 mc.

b. CRT SCREEN CALIBRATIONS.

(1) Amplitude Calibrations.

The screen has a linear amplitude calibration on the right side of the scale (1.0 to 0 in divisions of 0.1) and a logarithmic amplitude calibration on the left side of the scale (0 DB to 40 DB in 5-db divisions). When the front panel switch AMPLITUDE SCALE is set to LOGarithmic, the logarithmic calibrations are used. When this switch is set to the LINear or PWR (power) position, the linear calibrations are used. The linear calibrations are indicated by horizontal lines, the logarithmic calibrations by dots. (If so ordered, a calibrated screen can be supplied with horizontal lines for the logarithmic calibrations and dots for the linear calibrations.)

(2) Frequency Calibrations.

The screen has a linear frequency calibration scale, each division corresponding to one-tenth of the sweep width selected with the SWEEP WIDTH dial. This scale, called SWEEP WIDTH FACTOR, is calibrated from +0.5 to -0.5 in 0.1 divisions.

c. CENTER FREQUENCY DIAL CALIBRATIONS.

The CENTER FREQUENCY dial of the Model SPA-3 is calibrated from 0 to 13.5 MC in 0.5-mc divisions. The CENTER FREQUENCY dial of the Model SPA-3/25 is calibrated from 0 to 23.5 MC in two bands. The calibrations are 0.5-mc apart. ~~The Center Frequency Vernier is not calibrated.~~

d. SWEEP WIDTH DIAL CALIBRATIONS.

The SWEEP WIDTH dial is calibrated from 0 to 3 mc.

e. INPUT AMPLITUDE RANGE.

By appropriate selection of controls, full scale LINear (i.e., AMPLITUDE SCALE set to LINear) deflection can be obtained for input voltages between ~~20~~ 25 microvolts and ~~2~~ 1.4 volts. Full scale LOGarithmic (i.e., AMPLITUDE SCALE set to LOGarithmic) can be obtained for input voltages between ~~200~~ 250 microvolts and ~~2~~ 1.4 volts.

f. RELATIVE VOLTAGE ACCURACY.

±15% throughout the frequency range of 1 KC to 13.5 MC or 23.5 MC on the LINear amplitude scale.

±1.5 db throughout the frequency range of 1 KC to 13.5 MC or 23.5 MC on the LOGarithmic amplitude scale.

---

* Mounted on the rear apron of the analyzer-section chassis.

** Mounted on the rear apron of the Model PS-19 chassis.

±30% throughout the frequency range of 1 KC to 13.5 MC or 23.5 MC on the PWR (power) amplitude scale.

Residual harmonic products of a single frequency input of maximum allowable voltage on any input range are suppressed by at least 46 db. Maximum allowable voltages are given in III-4b(3).

g. RESOLUTION.

Resolution is defined as the frequency separation of two signals of equal amplitude, the deflections of which intersect 50% down from their peak amplitudes. Figure I-2 includes resolution curves for various sweep rates as a function of sweep width.

h. MEASUREMENT OF UNEQUAL AMPLITUDE SIGNALS.

Figure I-3 indicates minimum frequency separations required to measure signals of various amplitude ratios at various scanning velocities (scanning velocity being the product of sweep rate times sweep width).

i. SWEEP RATE.

The sweep rate is continuously variable from 1 cps to 60 cps with one control. The sweep may be either free running, or synchronized with the ac power line, or externally synchronized.

j. INPUT IMPEDANCE.

The input impedance is 72 ohms. (50-ohm input impedance available on special order.) High-impedance signal sources require the use of a special probe, Model PRB-1a. See section VI-1.

k. FREQUENCY MARKERS.

Internal crystal-controlled frequency markers of 500 kc and its harmonics ~~are provided~~.
and 50KC and its harmonics are provided

l. POWER SUPPLY.

The PS-19 is factory wired for operation from a 50-cps to 60-cps, 118-volt source. It is supplied with an external constant-voltage transformer in order to maintain adequate operating stability over a line variation from 95 to 130 volts. The standard transformer supplied is rated for 250 va at 60 cps. For a 50-cps and/or 230-volt line, a suitable substitute will be furnished. The constant-voltage transformer must be used at all times. It should not be used to supply accessory or additional equipments.

I-6. PHYSICAL CHARACTERISTICS

a. WEIGHTS

Description	Weight
Analyzer Section	33 lbs
Model PS-19	27 lbs
Spectrum Analyzer (including PS-19) in cabinet	108 lbs
Constant-Voltage Transformer	24 lbs

b. DIMENSIONS

Description	
Interconnecting cable, power, 14 wire, W24-25P5	25½" c to c
Interconnecting cable, power, 5 wire, W34-96	8 ft. long
Line Cord, ac, 3 wire, with adaptor, W4-72	6 ft. long

Dimensions of analyzer, power supply and constant-voltage transformer are shown in Figures II-1, 2, 3 and 4.

I-7. TUBE COMPLEMENT

a. ANALYZER SECTION

REFERENCE SYMBOL	TUBE TYPE	FUNCTION
V101	6922 ~~6BQ7A~~	Input Cascode Amplifier
V102	6CB6	Wide-Band Input Amplifier
V103	6J6	Phase Splitter
V104	5879	P/o Balanced Modulator
V105	5879	P/o Balanced Modulator
V106	6AW8A	A: 32-MC IF Amplifier B: 29.3-MC Crystal Oscillator

continued

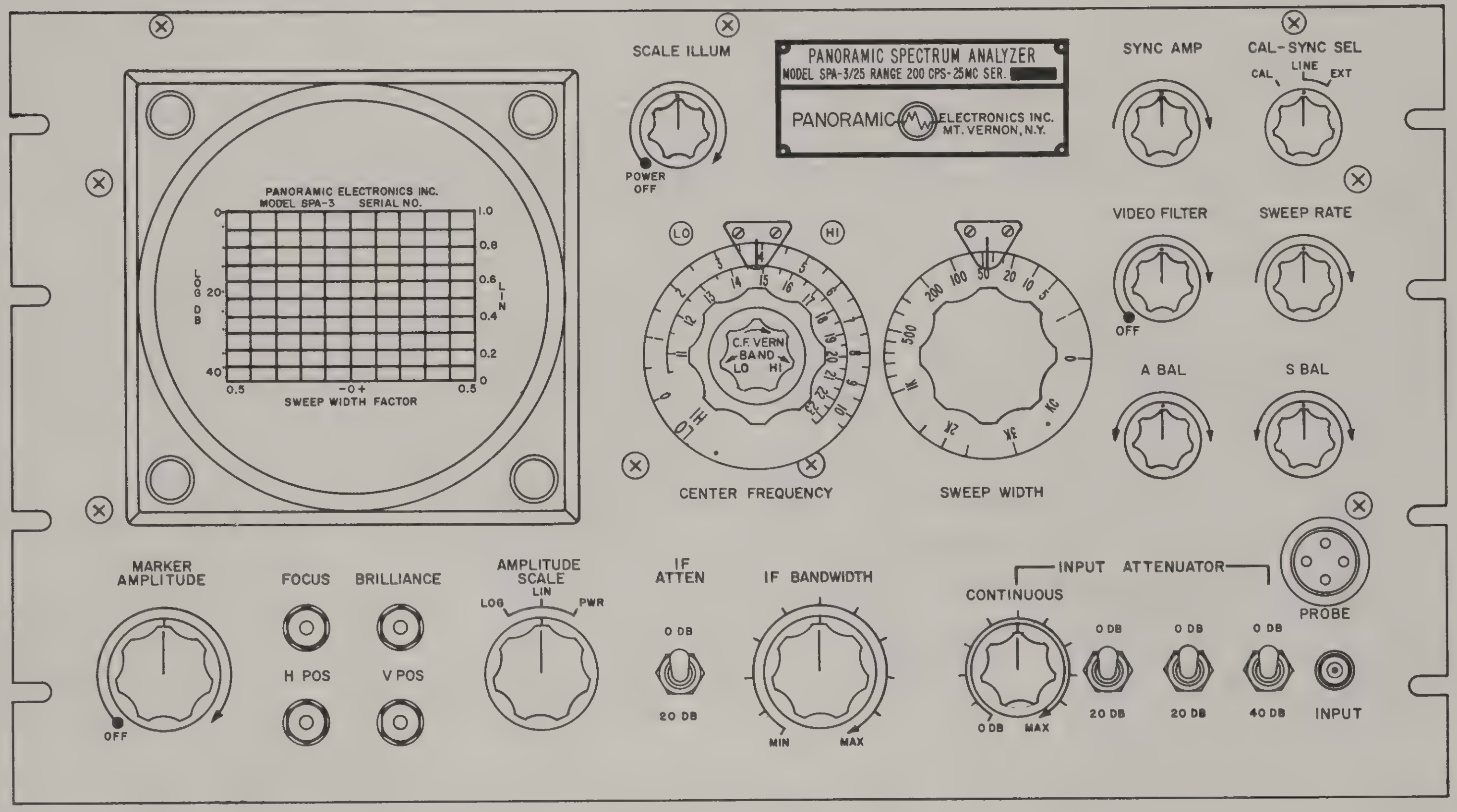
PANORAMIC SPECTRUM ANALYZER
MODEL SPA-3/25 RANGE 200 CPS-25MC SER.
PANORAMIC ELECTRONICS INC. MT. VERNON, N.Y.
PANORAMIC ELECTRONICS INC.
MODEL SPA-3 SERIAL NO.
LOG DB
0
20
40
LIN
1.0
0.8
0.6
0.4
0.2
0
0.5
-0+
0.5
SWEEP WIDTH FACTOR
SCALE ILLUM
POWER OFF
SYNC AMP
CAL-SYNC SEL
CAL
LINE
EXT
VIDEO FILTER
OFF
SWEEP RATE
A BAL
S BAL
LO
HI
C.F. VERN
BAND
LO HI
CENTER FREQUENCY
SWEEP WIDTH
KC
MARKER AMPLITUDE
OFF
FOCUS
BRILLIANCE
H POS
V POS
AMPLITUDE SCALE
LOG
LIN
PWR
IF ATTEN
0 DB
20 DB
IF BANDWIDTH
MIN
MAX
INPUT ATTENUATOR
CONTINUOUS
0 DB
MAX
0 DB
20 DB
0 DB
20 DB
0 DB
40 DB
PROBE
INPUT

Figure I-5. Front Panel, Model SPA-3/25 Analyzer Section.

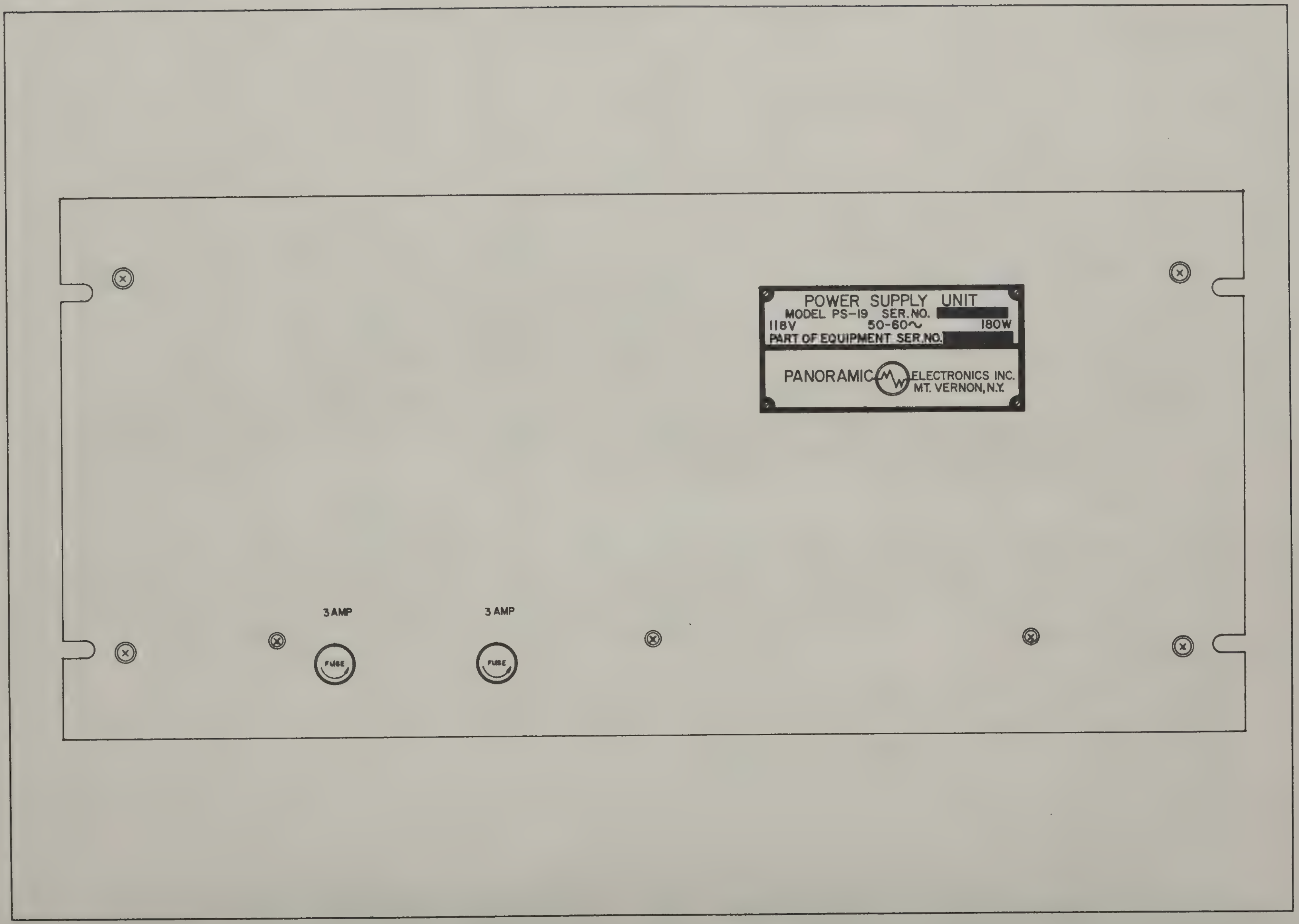
POWER SUPPLY UNIT
MODEL PS-19 SER. NO.
118V 50-60~ 180W
PART OF EQUIPMENT SER. NO.
PANORAMIC ELECTRONICS INC.
MT. VERNON, N.Y.
3 AMP
FUSE
3 AMP
FUSE

Figure I-6. Front Panel, Model PS-19.

REFERENCE SYMBOL	TUBE TYPE	FUNCTION
V107	6BE6	Mixer
V108	6AB4	First Crystal-Filter Stage (2.7 MC)
V109	6AW8A	A: First 2.7-MC Tuned IF Amplifier
		B: Second Crystal-Filter Stage (2.7 MC)
V110	6CB6	Second 2.7-MC Tuned IF Amplifier
V111	6AU6	Third 2.7-MC Tuned IF Amplifier
V112	12AU7	A: Detector (LIN-LOG Amplitude Scale)
		B: Audio Output Amplifier
V113	12AT7	A: Detector (PWR Amplitude Scale)
		B: Amplifier for PWR Amplitude Scale
V114	12AU7	A: Vertical Amplifier
		B: Vertical Phase Inverter and Amplifier
V115	12AX7	A: 500-KC-Marker Crystal Oscillator
		B: Marker-~~Output Cathode Follower~~ HARM GEN
~~V116~~	~~OA2~~	~~Voltage Regulator for Sweeping-Oscillator Section~~
V117	12BY7	Sawtooth Amplifier for Sweeping-Oscillator Section
V118	6BK7	Sweeping Oscillator
V119	6J6	A: Sweeping-Oscillator Output Amplifier
		B: Sweeping-Oscillator Output Amplifier for Model G-6
V120	12AT7	Sync Amplifier
V121	6U8	A: Sawtooth Generator
		B: Sawtooth-Output Cathode Follower
V122	12AU7	A: Horizontal Amplifier
		B: Horizontal Phase Inverter and Amplifier
V123	5ADP7	Visual Indicator (CRT)
V124	6AH6	500 KC MARKER CRYSTAL OPERATOR

b. POWER-SUPPLY SECTION (PS-19).

REFERENCE SYMBOL	TUBE TYPE	FUNCTION
V1	5U4	Full-Wave Rectifier (B+ Supply)
V2	6146	P/o Series Regulator (B+ Supply)
V3	6146	P/o Series Regulator (B+ Supply)
V4	12AX7	Regulator Control Tube (B+ Supply)
V5	12AX7	Regulator Control Tube (B+ Supply)
V6	5651 or Amperex OG3/85A2	Regulator-Control Voltage Standard
V7	5651 or Amperex OG3/85A2	Voltage Regulator (B- Supply)

I-8. TERMS AND DEFINITIONS

a. PANORAMIC RECEPTION is the simultaneous visual reception of one or several frequency sources whose frequencies are distributed over a continuous portion of the frequency spectrum. This definition distinguishes Panoramic reception from the conventional reception which can be called "uni-signal" reception and which can be either aural, or visual, or both.

The main distinction between panoramic and uni-signal reception is the following: Panoramic reception is periodic reception over a wide range of the spectrum. Each signal is received at fixed, rapid intervals, for a short period of time. At higher sweep rates, these signals are received so rapidly as to appear to be continuous on the crt screen because of the persistence of the screen material and retentivity of vision. Uni-signal reception is continuous reception, of the one signal at a time, over a very narrow range of the spectrum.

b. SWEEP WIDTH is the band, measured in cycles, kilocycles or megacycles, which can be observed by Panoramic reception and which corresponds to the range of oscillator sweep in the Panoramic equipment.

c. FREQUENCY SWEEP AXIS is the horizontal line along which the signal deflections are produced and which can be calibrated in frequency according to a given frequency scale. The frequency scale used is a multiplication factor of the SWEEP WIDTH dial setting (SWEEP WIDTH FACTOR calibrated from -0.5 to +0.5 in divisions of 0.1).

d. CENTER FREQUENCY is the frequency of the signal received on that part of the frequency sweep axis corresponding to zero sweep width.

e. RESOLUTION is defined as the frequency difference between two signals of equal deflection amplitude, the pips of which intersect 30% down from their peak value. This characteristic corresponds to selectivity in ordinary receivers. The smaller this frequency difference, the better is the resolution.

f. SWEEP FREQUENCY (sweep rate) is the number of times per second the electron beam sweeps across the cathode-ray tube.

g. DEFLECTION AMPLITUDE is the visual equivalent of signal input voltage. It is the height of a given signal deflection measured from the baseline to the top of the deflection.

h. SCANNING VELOCITY is defined as the frequency band scanned by the equipment per unit time. When the frequency spectrum is scanned linearly, scanning velocity is the product of the sweep rate and the sweep width.

$$\begin{aligned}\text{Scanning Velocity} &= \text{Sweep Rate (sweeps/sec)} \\ &\quad \text{X Sweep Width} \\ &\quad \text{(cycles/sec/sweep)} \\ &= \text{cycles/sec}^2\end{aligned}$$

CHAPTER II
INSTALLATION

II-1. UNPACKING AND INITIAL INSPECTION

This instrument has been tested and calibrated before shipment. Only minor preparations are required to put the instrument in operation.

If damage to the case is evident when delivery is made, have the person making the delivery describe the damage and sign the notation on all copies of the delivery receipt.

Most public carriers do not recognize claims for concealed damage if such damage is not reported within fifteen days after delivery. All shipping containers should be opened and the equipment inspected before fifteen days elapse.

If damage is found when the equipment is delivered, whether concealed or obvious, call or write the carrier and ask that an inspection be made by their agent. Although the carrier is liable for any damage in the shipment, Panoramic Electronics, Inc. will assist in describing and providing for repair or replacement of damaged items.

Be careful in unpacking and handling the equipment to avoid damage or undue exposure to the elements. Check the contents against the packing list and Chapter I, Section 4 to avoid loss of parts in the packing material.

The equipment is shipped with all its tubes and crystals already installed. Check that tubes, crystals, and other "pluck-out" components are well seated.

II-2. MOUNTING

The equipment (Model SPA-3 or SPA-3/25 with power supply) is normally supplied mounted in a common carrying case. The constant-voltage transformer is supplied separately. The equipment if removed from its carrying case can be mounted in a standard, 19-inch, electrical-equipment rack.

The equipment should be located for effective ventilation, in an area where the ambient light is not excessively bright. Locate the constant-voltage transformer for effective ventilation and as far from the analyzer unit as possible in order to minimize hum pickup. Areas with a high level of electrical disturbance should be avoided. A convenient source of suitable ac power (see section II-3) is required.

See figures II-1 to II-4 for outline dimensional drawings of the various units.

II-3. INTERCONNECTING PROCEDURE

a. The Power Supply, Model PS-19 is factory wired for 118-volt, 50- to 60-cycle operation. In order to deliver a stable supply of this power requirement, a constant-voltage transformer is supplied.* This transformer must be considered an integral part of the Panoramic equipment and must be used at all times. Do not, however, use it to supply power to auxiliary or additional equipments. For satisfactory operation of the Panoramic equipment, the constant-voltage transformer must be used only within the input voltage range and only at the frequency specified on its nameplate. Normally, a 95- to 130-v, 60-cps constant-voltage transformer is supplied. The following voltage-frequency combinations can be supplied if specified on the purchase order.

Input Voltage	Frequency	Output Voltage
95 - 130 v	50 cps	118
190 - 260 v	60 cps	118
190 - 260 v	50 cps	118

b. The equipment normally is shipped with the interconnecting cable between the analyzer unit and power supply already installed. Be sure that all plugs are well seated. If the equipment is supplied less cabinet (ie, for rack mounting), the 14-wire interconnecting cable must be connected between the 14-contact male receptacle on the rear apron of the analyzer-section chassis and the 14-contact female receptacle on the rear apron of the power-supply chassis.

c. Connect the constant-voltage transformer to the power supply, using the supplied five-wire cable.** The appropriate five-contact male receptacle is located on the rear apron of the power-supply chassis.

---

* If so ordered, the equipment is supplied less constant-voltage transformer and modified for operation from a well-regulated ±1%, 118-v, 50- to 60-cps power line. The power line must provide the same waveform as does the constant-voltage transformer or, if the power line provides a distortion-free voltage, the power supply is appropriately modified at the factory.

** If the equipment is modified for operation without the constant-voltage transformer (see footnote, section II-3a), it is only necessary to connect the 3-wire line cord. Be sure the center pin of the 3-wire cord is grounded.

Connect the three-contact, twistlock receptacle on the rear apron of the power-supply chassis to the ac power line using the supplied three-wire, ac line cord.

CAUTION

Be sure that the power line is appropriate for the constant-voltage transformer being used both as to voltage and frequency. Refer to the constant-voltage-transformer nameplate for input requirements.

If the power source does not accommodate the three-wire cord (center pin grounded) then the supplied adapter should be used. If the adapter is used, the ground wire of the adapter must be connected to a suitable external ground.

d. Signal input from a 72*-ohm source is connected to the front panel INPUT receptacle, through a suitable input cable. This input cable should be fabricated from RG-59/U coaxial cable and be terminated at one end with a type BNC plug to match the INPUT receptacle. The other end should be terminated suitable to the signal source.

To insure flatness of response, if the output impedance of the source is low but other than 72* ohms, a suitable matching pad should be inserted between the signal source and the input cable on the Model PRB-1a probe (supplied only if ordered) should be used. See section VI-1 for information relating to the probe.

To connect signals from a high-impedance source, the Model PRB-1a probe should be used.

II-4. INSTALLATION ADJUSTMENTS AND CHECKS

NOTE

If the adjustments given in this section fail to give the indicated results, Chapter V of the Instruction Manual should be referred to for appropriate maintenance action. Refer to Chapter III for details concerning operating techniques.

a. Set the following front-panel controls as listed.

CENTER FREQUENCY Dial . . .10 MC
SWEEP WIDTH Dial . . . . .3 MC
SWEEP WIDTH RANGE SEL . . . . . . WIDE
AMPLITUDE SCALE . . . . . . .LOGarithmic
IF ATTENuator . . . . .15 ~~20~~ DB
INPUT ATTENUATOR,
STEP . . . . .80 DB
INPUT ATTENUATOR,
CONTINUOUS . . . . .MAXimum
IF BANDWIDTH . . . . .MAXimum
VIDEO FILTER . . . . .OFF
MARKER ~~AMPLITUDE~~ . . . . . .OFF
CAL-SYNC SELector . . . . . . .LINE
SYNC AMPLitude . . . . .Completely counterclockwise

Be sure that the shorting plug is securely seated in the ACCESSORY EQUIPMENT receptacle at the rear of the analyzer chassis.

b. Switch on the equipment by rotating the SCALE ILLUMination control fully clockwise. The crt screen edge lighting should go on immediately.

Within 30 seconds, a dot should appear on the screen and within a few seconds start to sweep across the screen. This moving dot is the baseline trace. If nothing appears on the screen turn the BRILLIANCE control clockwise with a screwdriver.

CAUTION

If a stationary dot appears on the screen, turn the power off and refer to Chapter V for appropriate action.

c. The baseline trace should coincide with the baseline of the calibrated screen. If there is a lack of parallelism, it is necessary to rotate the cathode ray tube.

WARNING

Be careful of the high-voltage leads of the crt.

This can be done after loosening one of the two screws holding the crt socket clamp. When parallelism has been obtained, be sure that the crt is fully forward before retightening the screws.

If the baseline trace does not coincide with the baseline of the calibrated screen, a suitable adjustment of the Vertical POSition control should be made.

The baseline trace should extend at least 1/8 inch beyond the calibrated portion of the crt screen at all sweep rates and not extend past the edges of the crt screen at least at one sweep rate. See "e" below for the technique of setting sweep rate and obtaining sweep synchronization.

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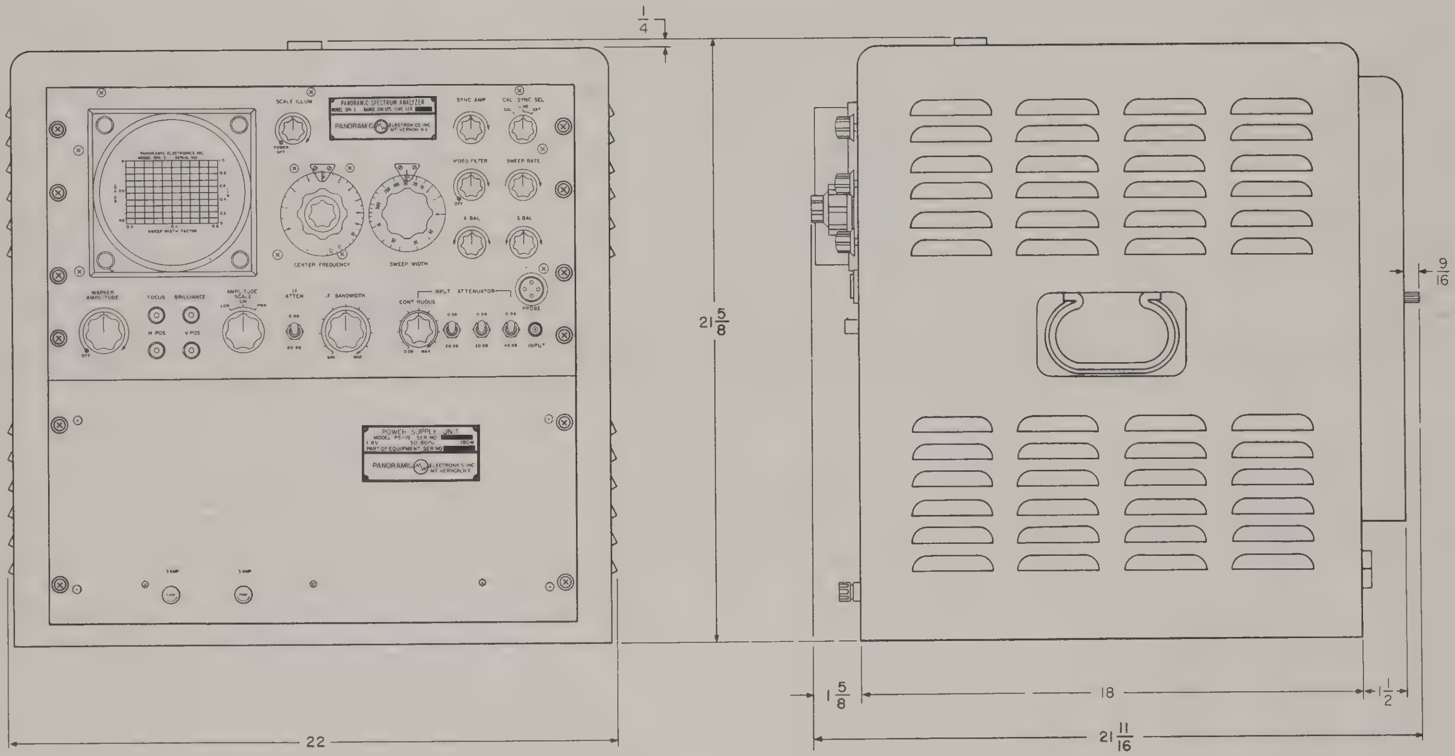
* 50, if the spectrum analyzer is supplied with 50-ohm input impedance.



1/4
21 5/8
9/16
1 5/8
18
1 1/2
21 11/16
22
SCALE ILLUM
POWER OFF
PANORAMIC SPECTRUM ANALYZER
PANORAMIC ELECTRONICS INC MT VERNON N.Y.
SYNC AMP
CAL SYNC SEL
VIDEO FILTER
SWEEP RATE
A BAL
S BAL
CENTER FREQUENCY
SWEEP WIDTH
SWEEP WIDTH FACTOR
MARKER AMPLITUDE
FOCUS
BRILLIANCE
H POS
V POS
AMPLITUDE SCALE
LOG
LIN
PWR
IF ATTEN
IF BANDWIDTH
INPUT ATTENUATOR
CONTINUOUS
PROBE
INPUT
OFF
POWER SUPPLY UNIT
MODEL PS-19 SER NO
PART OF EQUIPMENT SER NO
PANORAMIC ELECTRONICS INC MT VERNON N.Y.
3 AMP
3 AMP

Figure II-1. Outline Dimensional Drawing, Models SPA-3 and SPA-3/25 (Including Model PS-19). Cabinet-Mounted Style.

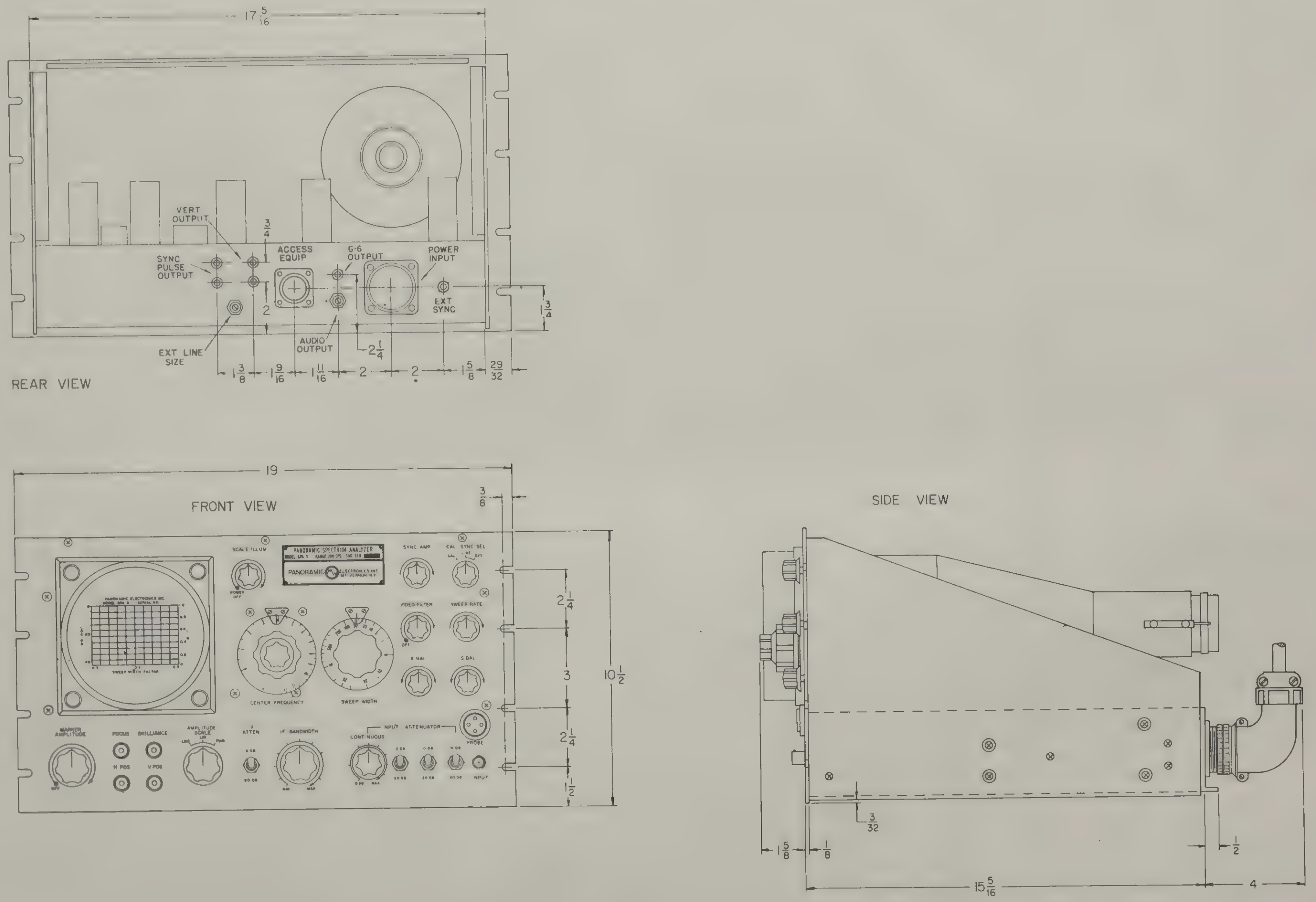

17 5/16
VERT OUTPUT
SYNC PULSE OUTPUT
ACCESS EQUIP
G-6 OUTPUT
POWER INPUT
EXT SYNC
EXT LINE SIZE
AUDIO OUTPUT
3/4
2
2 1/4
1 3/4
1 3/8
1 9/16
1 11/16
2
2
1 5/8
29/32
REAR VIEW
19
FRONT VIEW
3/8
SCALE ILLUM
PANORAMIC SPECTRUM ANALYZER
PANORAMIC ELECTRONICS INC MT. VERNON N.Y.
SYNC AMP
CAL SYNC SEL
VIDEO FILTER
SWEEP RATE
A BAL
S BAL
CENTER FREQUENCY
SWEEP WIDTH
SWEEP WIDTH FACTOR
MARKER AMPLITUDE
FOCUS
BRILLIANCE
H POS
V POS
AMPLITUDE SCALE
ATTEN
IF BANDWIDTH
INPUT ATTENUATOR
CONTINUOUS
PROBE
INPUT
2 1/4
3
2 1/4
1/2
10 1/2
SIDE VIEW
1 5/8
1/8
3/32
15 5/16
1/2
4

Figure II-2. Outline Dimensional Drawing, Analyzer Section. Rack-Mounted Style.

d. FOCUS, BRILLIANCE, (located on front panel) and ASTIG (located on analyzer chassis) are adjusted as required for a suitable trace. FOCUS and ASTIG should be set for a clear, sharp, uniform trace. BRILLIANCE should be set at the minimum point of suitable visibility. Do not use the BRILLIANCE control to compete with external light falling on the crt screen but rather reduce the external light or shield the screen.

e. Rotate SWEEP RATE control throughout its range noting that clockwise rotation increases the rate.

Turn CAL-SYNC SELector to CAL. The baseline will become a series of sine waves, the number of which indicates the sweep rate. The sweep rate is determined by counting the number of cycles on the screen and dividing this number into 60.* (Eg, if there are 2 cycles on the screen, the sweep rate = 60 ÷ 2 = 30 cps.) To synchronize the sweep to the power line, adjust the SWEEP RATE control such that the appropriate number of cycles appear on the screen and are almost stationary with a slight drift to the left. Then rotate the SYNC AMPLitude control clockwise until the cycles become stationary. If the baseline becomes too short, excessive sync (control too far clockwise) is being provided. Minimum sync amplitude consistent with good synchronism is the best setting. Note that at low sweep rate, it is easier to count sweeps, using a stop watch for timing, than to count cycles.

Set SWEEP RATE and SYNC AMPLitude for a stable 30-cps rate (2 cycles on the screen). Return the CAL-SYNC SELector to the LINE position.

NOTE

> The equipment must be turned on and allowed to warm up for at least one-half hour before the following checks are made:

f. Turn the CENTER FREQUENCY dial to 0. With the Model SPA-3/25, be sure that the ~~Center~~ ADJ c ~~Frequency VERNier~~ is set for the LO BAND. This is done by turning the control to the extreme counterclockwise position until the switch is actuated. A rise or deflection of the baseline around the center of the screen may or may not be present. The presence of this pip indicates an unbalanced condition in the balanced modulator. Manipulate the A BALance and S BALance controls alternately to minimize this deflection. Set the IF ATTENuator to 0 DB and rebalance. With change of setting of the IF ATTENuator from 15 ~~20~~ DB to 0 DB the balance controls should become more critical, indicating increased sensitivity of the intermediate-frequency section. It may not be possible to completely eliminate the deflection, in which case proper balance is indicated by the presence of a minimum amplitude double hump that resembles an "m".

g. Change control settings as follows:

CENTER FREQUENCY............ 10 MC
AMPLITUDE SCALE .... LINear
MARKERS 500KC

~~Switch the internal markers on by rotating the MARKER AMPLITUDE control clockwise.~~ Adjust the control for a convenient height of marker presentation. The 10-mc marker pip should be at or near the center of the screen. Gradually reduce SWEEP WIDTH to minimum, maintaining the 10-mc pip at the center of the screen with the CENTER FREQUENCY control. Return to 3-mc sweep width and adjust Horizontal POSition until the top of the pip coincides with the center vertical line (0 frequency calibration) on the screen. With the SWEEP WIDTH dial set for 3 MC and the CENTER FREQUENCY dial set for 10 MC, the 11.5 mc marker pip should fall within ±1/2 division of the -0.5 calibration mark. Note that the marker pips are 0.5 mc apart.

h. Check the IF BANDWIDTH control by reducing the sweep width until the base of a centered, half-scale, 10-mc marker pip occupies approximately one-third of the screen width. Then slowly turn IF BANDWIDTH counterclockwise. The pip width should decrease. At the same time there may be a change in pip height. Maintain a half-scale pip by adjusting the MARKER AMPLITUDE control. As IF BANDWIDTH is turned counterclockwise small convolutions of "ringing" will appear on the trailing edge of the pip. Optimum resolution occurs when the first convolution beyond the apex of the pip dips into the baseline. Section III-4d(5) contains a more extended discussion of the variation of screen presentation with change in IF BANDWIDTH setting.

i. Using the marker pips, check the SWEEP WIDTH dial calibrations corresponding to frequencies above 0.5 mc. Set the SWEEP WIDTH to 3 MC and CENTER FREQUENCY to 1.5 MC. Turn MARKER AMPLITUDE on and set it for a convenient amplitude of marker display. The zero-frequency pip should be at or near the -0.5 calibration mark of the SWEEP WIDTH FACTOR screen scale. (It may be necessary to adjust A BALance and/or S BALance to unbalance the equipment sufficiently to see the zero-frequency pip.) The sixth marker pip to the right of the zero-frequency pip should be at or near the +0.5 mark of the SWEEP WIDTH FACTOR scale. (Each pip being 0.5-mc apart, the sixth pip to

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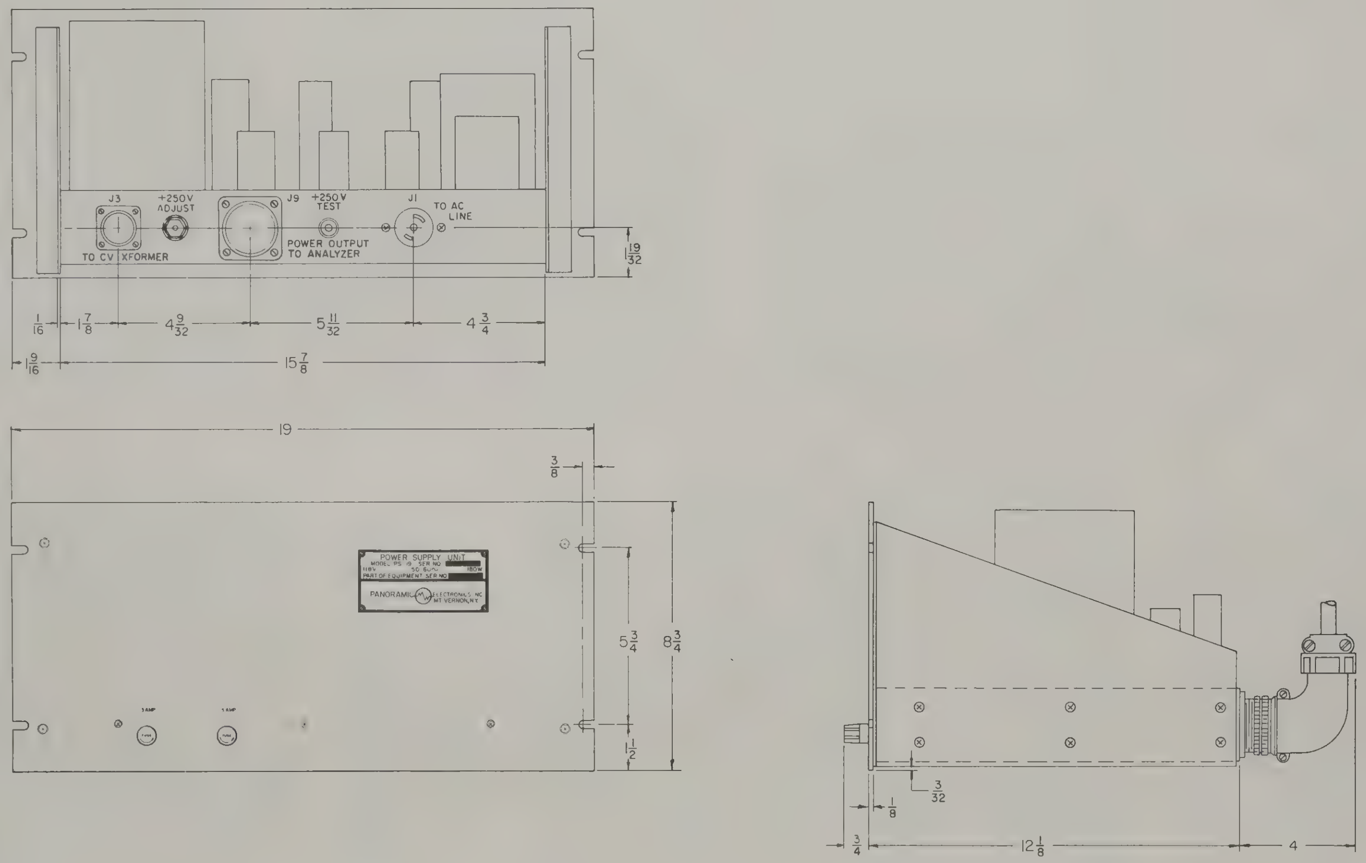
* 50 if the power-line frequency is 50 cps.



J3
+250V ADJUST
TO CV XFORMER
J9
+250V TEST
POWER OUTPUT TO ANALYZER
J1
TO AC LINE
1 19/32
1/16
1 7/8
4 9/32
5 11/32
4 3/4
1 9/16
15 7/8
19
3/8
5 3/4
8 3/4
1 1/2
POWER SUPPLY UNIT
MODEL PS 19 SER NO
118V 50 60~ 180W
PART OF EQUIPMENT SER NO
PANORAMIC ELECTRONICS INC MT VERNON, N.Y.
3 AMP
3 AMP
3/32
1/8
3/4
12 1/8
4

Figure II-3. Outline Dimensional Drawing. Model PS-19. Rack-Mounted Style.

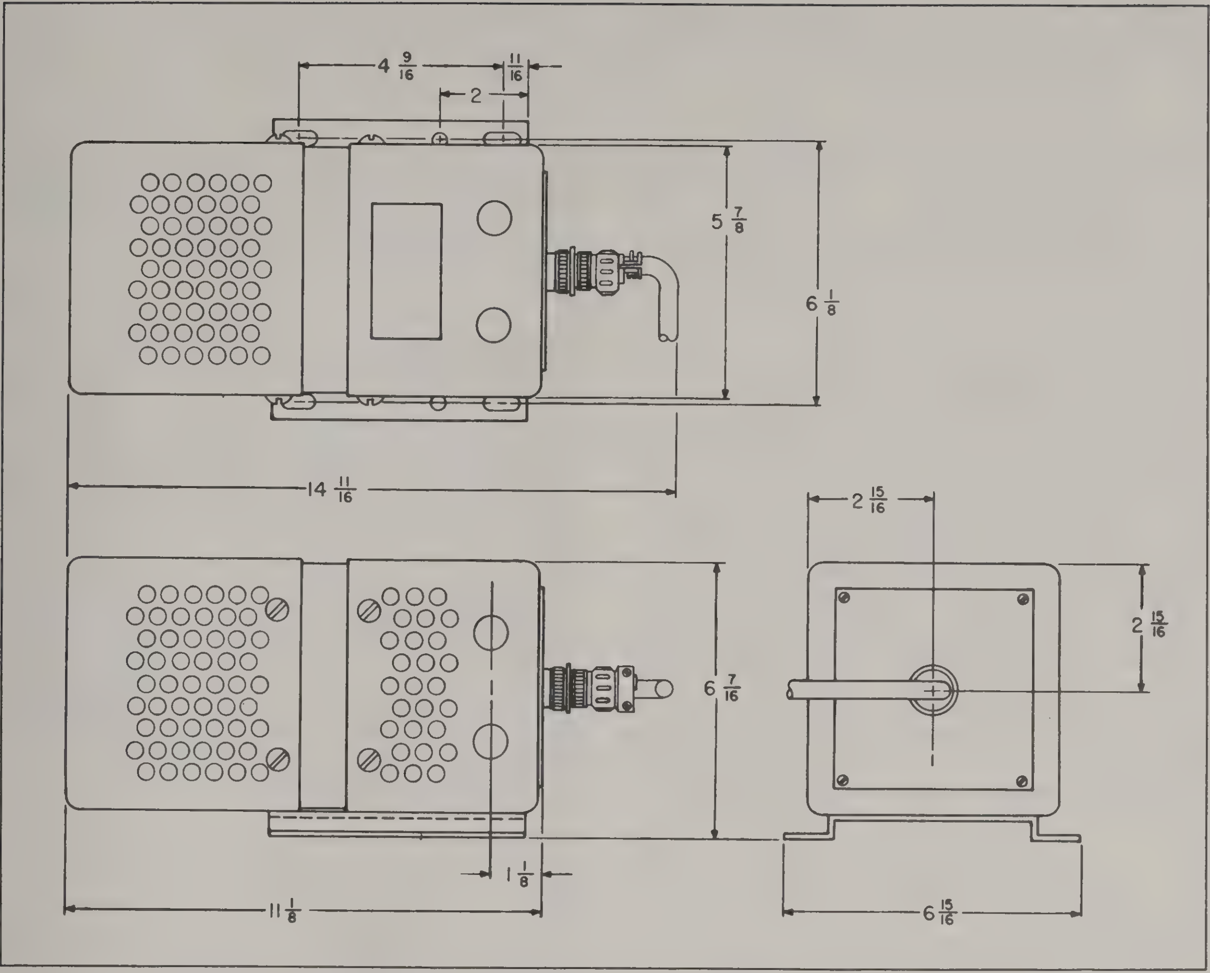


Figure II-4. Outline Dimensional Drawing. Constant-Voltage Transformer.

the right of the zero-frequency pip corresponds to a frequency of 3 mc. Since SWEEP WIDTH is set for 3 MC, a 3-mc pip should fall at +0.5 when the zero-frequency pip falls at -0.5 on the SWEEP WIDTH FACTOR scale.) Note that it may be necessary to adjust CENTER FREQUENCY to center this display of six marker pips plus the zero-frequency pip. Other SWEEP WIDTH dial calibration in increments of 0.5 mc between 0.5 MC and 3 MC can be checked using the 500-kc-apart marker pips. For example, setting the CENTER FREQUENCY dial for 1.75 MC and the SWEEP WIDTH dial for 0.5 MC, marker pips should appear at +0.5 and -0.5 on the SWEEP WIDTH FACTOR scale (approximately).

To check sweep widths narrower than 0.5 mc, an amplitude-modulated signal may be used. The modulating source should be set to a frequency equal to one-half the SWEEP WIDTH dial setting. The CENTER FREQUENCY dial should be set to the carrier frequency. The upper and lower side bands may then be used to determine the actual sweep width. Note that in order to have suitable pips at narrow sweep widths it may be necessary to reduce the sweep rate and the if bandwidth thereby improving resolution. Section III-4d contains a more extended discussion of narrow-band techniques.

j. Check the CENTER FREQUENCY dial by setting the SWEEP WIDTH dial to 3 mc and then matching the CENTER FREQUENCY dial calibrations with the corresponding marker frequency (starting with the CENTER FREQUENCY dial set to 0). The top of the pip should appear at or near the center of the screen. Be sure that the Center Frequency VERNier is set such that the zero-frequency pip is at the center of the screen when CENTER FREQUENCY is set to 0.

k. Check the amplitude scales using a signal of variable and known amplitude and low distortion. The voltages given in these checks are approximate since the instrument measures relative amplitude rather than absolute amplitude. Any convenient fixed CENTER FREQUENCY and SWEEP WIDTH settings compatible with the generator frequency and pip readability may be used. Set the controls as follows:

AMPLITUDE SCALE	LINear
IF ATTENuator	0 DB
INPUT ATTENUATOR, CONTINUOUS	Completely counterclockwise
INPUT ATTENUATOR, STEP	0 DB
IF BANDWIDTH	MAXimum
VIDEO FILTER	OFF
SWEEP RATE	30 cps

A signal input amplitude of approximately 20 microvolts should result in a full-scale pip. Adjust generator level if necessary for a full-scale pip. Change the INPUT ATTENUATOR, STEP to 20 DB. The signal input amplitude required for full-scale deflection should be approximately 200 microvolts. Change IF ATTENuator to 20 DB and INPUT ATTENUATOR, STEP to 0 DB. The pip should remain full scale. Set IF ATTENuator to 0 DB and INPUT ATTENUATOR, STEP to 40 DB, 60 DB, and then 80 DB. The signal input amplitude required for full-scale deflection should be approximately 2 millivolts, 20 millivolts, and 200 millivolts respectively. With IF ATTENuator at 20 DB and INPUT ATTENUATOR, STEP at 80 DB, an approximately 2-volt input should result in a full-scale deflection. Return INPUT ATTENUATOR, STEP to 40 DB and IF ATTENuator to 0 DB. Reduce input amplitude to approximately 2 millivolts to obtain a full-scale pip. Increase input amplitude to 20 millivolts and rotate INPUT ATTENUATOR, CONTINUOUS completely clockwise. The pip should be less than full scale, indicating more than a 20-db range in this control. Return INPUT ATTENUATOR, CONTINUOUS to the full counterclockwise position and adjust the input amplitude for a full-scale pip.

Switch AMPLITUDE SCALE to LOGarithmic. The pip amplitude should be in line with the 20 DB calibration dot on the left side of the calibrated crt scale. Change INPUT ATTENUATOR, STEP to 20 DB. Pip amplitude will again increase to full scale. Intermediate amplitude calibration points on the crt screen for both the LINear and LOGarithmic positions of AMPLITUDE SCALE may be checked against known input levels.

Switch AMPLITUDE SCALE TO PWR (power). Using INPUT ATTENUATOR, STEP and CONTINUOUS, obtain a full-scale pip. Decrease the input amplitude of the signal 3 DB. The pip amplitude should decrease approximately 5 linear divisions of the crt screen. Note that because of a-c coupling in the circuit, the PWR (power) scale functions properly only with narrow pips and high sweep rates.

CHAPTER III

OPERATING INSTRUCTIONS

Haphazard operation or improper setting of controls can cause damage to the equipment and/or false or misleading results. Satisfactory results will be obtained if the equipment is operated carefully in accordance with the instructions found in this chapter.

For convenience, this chapter is divided into four sections.

Sections III-1 and III-2 describe the function of the operating and semi-adjustable operating controls. The controls listed in these two sections are the only controls required in operation. All other controls are used only in maintenance or service of the units. Such controls should not be adjusted by operating personnel but should be left to experienced service personnel and should be adjusted only in accordance with the procedures given in Chapter V.

Preliminary adjustments for operation are given in Section III-3. For best results, the preliminary adjustments should be made with care and exactness each time the equipment is turned on.

The techniques of operation for various types of measurements are given in Section III-4. The use of optional accessory equipment to extend the application of the equipment is discussed in Chapter VI. While it is not possible to cover all possible measurement problems, the general procedures can be adapted to specific problems. Our Applications Engineering Section is available for consultation and assistance when special or unusual measurement problems are encountered.

III-1. OPERATING CONTROLS

The following controls are available to the operator. They are mounted on the front panel.

a. SWEEP WIDTH.

This control is used to set the width of the segment of the spectrum to be analyzed. The control provides any sweep width from 0 to 3 mc. in 4 ranges The sweep width is indicated on the associated calibrated dial.

b. CENTER FREQUENCY.

This control provides a continuously adjustable selection of the frequency which will appear under the 0 marker on the screen. In the SPA-3, the dial associated with this control is calibrated from 0 to 13.5 MC. In the SPA-3/25, the associated dial is calibrated from 0 to 23.5 MC in two bands.

b.1. SWEEP WIDTH RANGE SEL

This control is used to select the desired sweep width range. The ranges are 0 to 3 mc in

c. ZERO ADJ ~~CENTER FREQUENCY VERNIER~~ (and BAND SELECTOR for SPA-3/25).

This control (concentric with the CENTER FREQUENCY control) is used to set the calibration of the low frequency end of the CENTER FREQUENCY dial and as a vernier. On the SPA-3/25, this control also is used to select the frequency band.

c.1 FINE CENTER FREQ
This control is used as fine tuning for [illegible]

d. AMPLITUDE SCALE (LOGarithmic-LINear-PWR(power).

This three-position switch is used to select a logarithmic voltage-amplitude scale, a linear voltage-amplitude scale, or a power-amplitude scale.

e. SWEEP RATE.

This control provides continuously adjustable sweep rates between 1 cps and 60 cps. Clockwise rotation increases the sweep rate.

f. CALibration-SYNChronization-SELector

This switch has three positions: CALibration, LINE, and EXTernal. In the CALibration position, the sweep rate may be synchronized with the power-line frequency. The EXTernal position permits sweep synchronism by means of a suitable signal connected to the EXTernal SYNChronization receptacle (located on the rear apron of the analyzer chassis). Sweep without synchronism (free-running sweep) may be obtained in all three positions by setting SYNChronization AMPlitude completely counterclockwise.

g. SYNChronization AMPlitude

The amplitude of the sweep-synchronizing signal is adjusted with this control to provide for proper crt beam sweep synchronism. Maximum amplitude occurs at the maximum clockwise position. A free-running sweep is obtained by setting the control completely counterclockwise.

h. IF BANDWIDTH.

The bandwidth of the intermediate-frequency section is adjusted with this control. Clockwise rotation increases the i-f bandwidth.

i. INPUT ATTENUATOR.

(1) STEP Control.

Attenuation of 80 db in 20 db increments is provided.

(2) CONTINUOUS Control.

A full clockwise rotation of this control gives more than a 20-db attenuation of the input signal.

j. IF ATTENuation see add.

~~For any given setting of the INPUT ATTENUATOR controls, this switch provides 20 db additional attenuation when switched from 0 DB to 20 DB. The 20 DB position should only be used when the AMPLITUDE SCALE is on LINear or PWR (power). When on LOGarithmic, the IF ATTENuator must be set on 0 DB to avoid inadvertent overload.~~

k. MARKER AMPLITUDE. see add.

~~The amplitude of the internal crystal-controlled frequency markers (consisting of 500 kc and its harmonics) is varied with this control. Maximum marker amplitude is provided in the maximum clockwise position of the control. The control has an OFF position to turn the markers off.~~

l. VIDEO FILTER.

This control provides continuous adjustment of a smoothing filter located at the output of the detector. Clockwise rotation increases the degree of filtering. The control has an OFF position which disconnects the filter.

When the equipment is being used to measure discrete signals, the control is used to reduce noise, beats between signals close in frequency, etc. When the equipment is being used to measure noise spectra, the control is used to obtain averaging of the noise spectrum envelope.

m. A BALance and S BALance.

These controls are used to suppress an internally generated deflection which may appear on the crt screen when the CENTER FREQUENCY dial is at or near 0.

n. SCALE ILLUMination - POWER OFF.

Turning this control clockwise switches on the power to the equipment. The control is then used to adjust the intensity of edge lighting of the screen. The OFF position turns the power off.

III-2. SCREWDRIVER-ADJUST OPERATING CONTROLS

The screwdriver-adjustable controls listed in this section may be adjusted by the operator as required. Unless otherwise indicated, the controls are located on the analyzer-section front panel. The adjustment of all chassis components, other than those listed in this section, should be left to experienced maintenance personnel. Such maintenance controls should be adjusted only in accordance with the procedures outlined in Chapter V.

a. FOCUS.

This control adjusts the sharpness of the trace.

b. BRILLIANCE.

This control is used to adjust the intensity of the trace. Clockwise rotation increases the intensity.

c. Horizontal POSition.

This control is used to adjust the horizontal position of the trace on the screen. Clockwise rotation shifts the trace to the right.

d. Vertical POSition.

This control is used to adjust the vertical position of the trace on the screen. Clockwise rotation raises the trace.

e. ASTIGmatism (located on the analyzer-chassis).

This control is used to provide uniform focus throughout the trace.

f. LINE SIZE (located on the analyzer-section chassis.)

This control is used to obtain the proper line size. Clockwise rotation increases the line size.

h. CALIBRATION
Used to set range of Ctr Freq dial

III-3. PRELIMINARY ADJUSTMENTS

For best results, these preliminary adjustments should be made with care and exactness each time the equipment is turned on.

a. Set the following front-panel controls to the listed position:

SWEEP WIDTH Dial.	3 MC
CENTER FREQUENCY Dial.	10 MC
IF BANDWIDTH	MAXimum

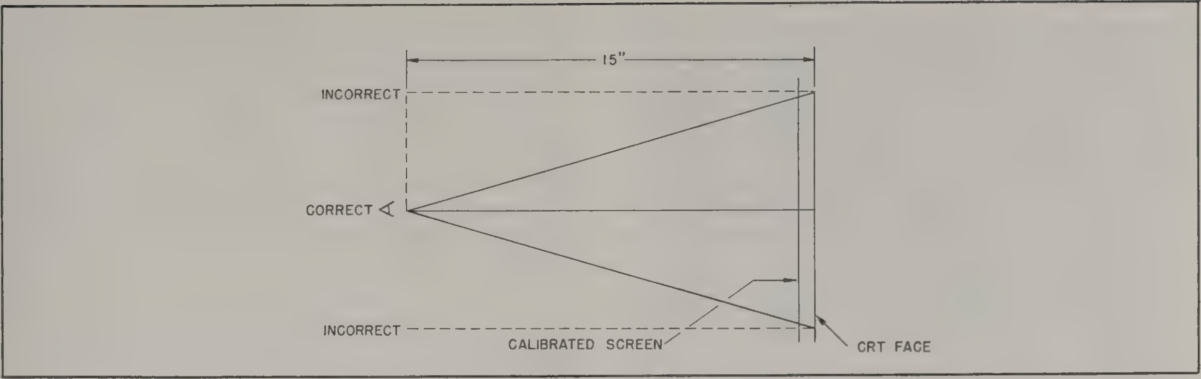


Figure III-1. Correct Viewing of CRT Screen.

AMPLITUDE SCALE . . . . LOGarithmic
IF ATTENuator. . . . . 0 DB
VIDEO FILTER. . . . . OFF

Be sure that the shorting plug is securely plugged into the ACCESSORY EQUIPMENT receptacle at the rear of the analyzer chassis.

b. Turn the power on by rotating SCALE ILLUMination clockwise. The crt screen edge lighting should go on immediately. Within 30 seconds, a dot should appear on the screen and within a few seconds start to sweep across the screen.

If nothing appears on the screen, turn the BRILLIANCE control clockwise. The BRILLIANCE should be set at a minimum point of suitable visibility and the FOCUS control for the finest clear line. A later adjustment of FOCUS and BRILLIANCE may be required, since the appropriate settings are partially dependent upon the signal density. Do not use the BRILLIANCE control to compete with external light falling on the crt screen but rather reduce the external light or shield the screen.

When viewing the crt screen, the eye of the observer should be along the axis of the crt at a distance of approximately 15 inches from the face of the crt. The screen calibrations have been made from this position. Hence, any other position will introduce parallax error. See Figure III-1.

If necessary, set Vertical POSition for coincidence of the baseline trace with the base of the calibrated crt scale.

For wide-band analysis, the instrument may be used within a few minutes although adjustment may be required as the instrument warms up. For narrow-band analysis, it is advisable to wait at least one-half hour to allow the unit to stabilize.

c. Set the CENTER FREQUENCY dial to 0 and adjust A BALance and/or S BALance so that the zero-frequency pip (see Figure III-2) is visible. With the Model SPA-3/25, be sure that the ~~Center Frequency VERNier~~ 0 ADJ CONT is set for LO BAND. This is done by turning the control to the extreme counterclockwise position until the switch is actuated. Adjust the ~~Center Frequency VERNier control~~ 0 ADJ CONT (concentric with the CENTER FREQUENCY control) so that the zero-frequency pip is at the center of the screen. Then adjust A BALance and S BALance to minimize the zero-frequency pip.

see add.

d. Set the CENTER FREQUENCY dial to 10 MC. ~~Turn MARKER AMPLITUDE on and adjust it for a convenient height of marker presentation. The 10-mc marker pip should be at or near the center of the screen.~~ THIS [illegible] IS PA OF PAR GRAP Gradually reduce the SWEEP WIDTH to minimum, maintaining the 10-mc pip at the center of the screen with the CENTER FREQUENCY control. Return to 3-mc sweep width and adjust Horizontal POSition until the top of the pip coincides with the center vertical line.

e. If desired, applicable installation checks (Section II-4) can be made. From this point, all

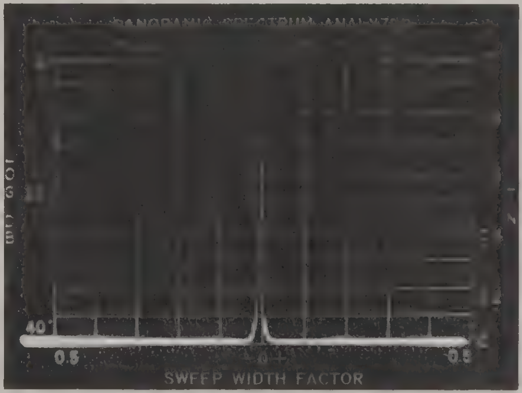


Figure III-2. Zero-Frequency Pip.

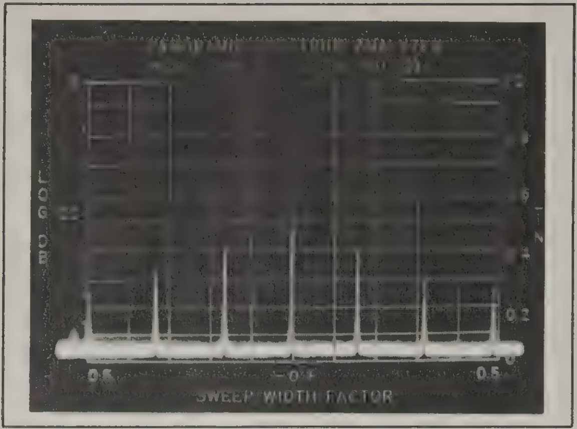


Figure III-3. Marker Presentation. 3-MC Sweep Width 10-Mc Center Frequency.

control settings are dependent upon the input signal characteristics and the type of measurements to be made.

III-4. OPERATING TECHNIQUES

Once the preliminary adjustments have been made, the instrument is ready for use. If the equipment is used during the warm-up period, frequency calibration adjustments may be necessary.

a. Classification of Input Signals.

Generally, input signals to the spectrum analyzer can be divided into two types: discrete and non-discrete. Discrete signals are periodic waveforms with frequency contents which do not vary appreciably with time. The internal markers of the equipment are typical of such a signal. Although there are several frequency components, each frequency is discernible as a separate pip providing the resolution of the spectrum analyzer is adequate for the frequency differences encountered. In practice, discrete signals are typical of periodic oscillation such as signal-generator and oscillator outputs and transducer outputs if a periodic vibration is encountered; for example, constant-speed rotating machinery with a well-defined resonant vibration. Non-discrete signals are typified by a random noise in which the input frequency distribution must be considered as spread out over a band of the spectrum, rather than consisting of line spectra. Random signals vary with time but usually have a definable means (rms) level. Non-discrete signals are shown on the spectrum analyzer as a varying envelope of amplitude at each spectrum sample. Several scans through the noise input signal usually are adequate to establish a meaningful relative amplitude-versus-frequency analysis. The amplitude scales are equally valid for both random and discrete signals. However, the equipment sensitivity for discrete signals is different from that for random signals. Discrete signal levels should be compared to other discrete signal levels and random to other random levels when relative signal strengths are being determined. In a generally complex signal where both random and discrete signals are present, the spectrum analyzer will show on average the levels of the noise and the levels of the discrete signals correctly. That is, the random and discrete deflections on average would not change if one or the other were removed from the input signal.

Sections "b", "c", and "d" below give operating techniques for discrete-signal measurements.

b. Relative-Voltage Measurements of Discrete Signals.

(1) Set the following controls to the listed positions.

SWEEP WIDTH Dial	3 MC
CENTER FREQUENCY Dial	0 MC
IF BANDWIDTH	MAXimum
IF ATTENuator	0 DB
AMPLITUDE SCALE	LOGarithmic
VIDEO FILTER	OFF

(2) Connect the test signals to the spectrum analyzer. The method of connection depends upon the nature of the signal source. Paragraph II-3d gives methods to be used to connect test signals from different types of sources.

(3) For correct results, the following limits on the instantaneous peak voltage of signals con-

Total Attenuation of					
INPUT ATTENUATOR, STEP and CONTINUOUS	0 DB	20 DB	40 DB	60 DB	80 DB
Maximum instantaneous peak voltage	300 uv	3 mv	30 mv	0.3 v	3 v
(LOGarithmic position of AMPLITUDE SCALE may ONLY BE USED IF IF ATTEN IS SET TO "0" ~~not be used when IF ATTENuator is set to 20 DB.)~~					

nected to the INPUT receptacle must be observed. Failure to limit the level to the indicated voltages may result in incorrect amplitude readings and indications of frequency components which are not present in the input signal. It should be noted, however, that even if large amplitude bursts do occur, if they are of very short time duration they can be ignored. They will cause spurious response for a very short period of time and thus will not appear on the crt for any significant length of time.

When evaluating the input level, it is necessary to measure the total amplitude present at the input whether related or extraneous, whether in the frequency range of the equipment (200 cps to 15 mc or 200 cps to 25 mc) or outside of the frequency range. The input amplitude should be measured with a broadband, fast-responding, peak-level indicator such as an oscilloscope*. If the presence of signals not related to the signals of interest are of sufficient amplitude to overload the equipment, it is advisable to use appropriate filters to eliminate the unrelated signals. In the case of noise analysis (noise being defined as randomly fluctuating signals), unless it is definitely known that the level of signal present above the spectrum of interest is negligible, it is good practice to use a low-pass filter to attenuate signals above the spectrum of interest.

As a rough check for overload, it should be noted that overload can be assumed to occur if, with AMPLITUDE SCALE set to LOGarithmic and IF ATTENuator set to 0 DB, deflections greater than full scale result. This does not mean that if the deflections are less than full scale, overload is not occurring.

Providing that the voltages indicated in the chart above are not exceeded, it is completely permissible to have crt deflections greater than full scale, thereby permitting study of low-level signals. The INPUT ATTENUATOR, STEP and, if necessary, the INPUT ATTENUATOR, CONTINUOUS are set to avoid overload. The IF ATTENuator is then set appropriate to the level of signals to be measured.

(4) With the CENTER FREQUENCY dial set to 0 and AMPLITUDE SCALE set to LOGarithmic, adjust A BALance and S BALance for maximum suppression of the zero-frequency pip. It should be noted that it is perfectly normal for the amplitude of the zero-frequency pip to vary with time. If the frequency region being examined is sufficiently remote from 0 that the zero-frequency pip is not on the screen, it is only necessary to be sure that the zero-frequency pip is less than full scale on the LOGarithmic scale when IF ATTENuator is set to 0 DB. It is good practice to confirm this degree of suppression occasionally. If the equipment is used near enough to 0 that the zero-frequency pip is on the screen, greater care in suppression may be required. If the zero-frequency pip is below full scale on the LOGarithmic scale with IF ATTENuator set to 0 DB and the signal pips do not tend to ride on the zero-frequency pip, the suppression is satisfactory. If the signal pip amplitudes are being influenced by the zero-frequency pip, if possible, adjust the equipment to improve the resolving capabilities (reduce the sweep width, reduce the sweep rate, and/or narrow the if bandwidth). If improvement of the resolving capabilities does not separate sufficiently the zero-frequency pip from the signal pips, adjust A BALance and S BALance for a suppression of the zero-frequency pip that is sufficient to prevent influence on the amplitude of the signal pips.

(5) Adjust the CENTER FREQUENCY dial to bring the desired test signals on the screen. With the SPA-3/25, be sure that the ~~CF VERNier~~ ZERO ADJ CONT is set for the appropriate band. If a closer examination is required, the sweep width may be reduced. The ~~Center Frequency VERNier~~ ZERO ADJ control (concentric with the CENTER FREQUENCY control) may be used as a ~~fine~~ coarse tuning adjustment. However, this use puts the CENTER FREQUENCY dial out of calibration. The dial may be restored to correct calibration by setting it such that the zero-frequency pip is at the center of the screen when the CENTER FREQUENCY dial is set to 0.

(6) The spectrum analyzer can be adjusted to provide any sweep rate from 1 cps to 60 cps. The spectrum analyzer sweep rate can be adjusted for synchronism to the power line, synchronism to an external signal, or non-synchronism. When the CAL-SYNC SELector switch is set to the EXTernal position, the sweep can be synchronized to a suitable signal connected to EXT SYNC receptacle (rear apron of analyzer chassis). When the switch is set to the LINE position, the sweep can be synchronized to the power line. When the SYNC AMPlitude control is turned completely counterclockwise, the sweep operates without synchronism. The technique of adjusting the sweep rate is given in paragraph II-4e.

The choice of appropriate sweep rate and mode of sweep synchronism of the spectrum analyzer is determined by the nature of the signals being studied. For example, when the test signals are sporadic in occurrence, it is desirable to operate the equipment at high sweep rates to increase the probability of intercepting the signal. One way to obtain better resolution is to decrease the sweep rate. When examining pulse spectra, increasing the sweep rate will reduce the number of pulse lines per scan. Thus, a high synchronous sweep rate permits determination of the pulse repetition frequency and also permits examination for missing pulse lines. On the other hand, a low sweep rate will increase the number of pulse lines per scan, thus giving better definition to the shape of the spectral distribution envelope. Examination of distributed spectra (for example, random noise) requires low sweep rates to obtain good definition (see III-4e).

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* Amplitude overloading of the input is determined by the instantaneous peak voltage of the input signal. However, in cases in which the peak amplitudes are no greater than 1.4 times the rms amplitude, a broadband true rms voltmeter may be used instead of an oscilloscope if more convenient.

In most applications the unsynchronized-sweep mode of operation provides more information than does the synchronized mode. However, it is often more convenient for viewing purposes to synchronize the sweep. For example, when examining a signal, unresolved modulations may be revealed as amplitude bobbing of the screen presentation when the sweep is not synchronous with the modulation frequency. Synchronizing the sweep to the modulation frequency will stop the bobbing. When viewing pulsed r-f signals, unsynchronized sweep will result in the continuous shifting across the screen of the pulse lines. This results in better definition of the spectral envelope. However, if examination for missing pulsed repetition frequency lines or determination of the pulse repetition frequency is desired, it is more convenient to synchronize the sweep to the pulse, thereby causing a stationary pattern on the crt screen. Note that if the pulse is synchronized to the power line, synchronism is more easily provided by synchronizing the spectrum analyzer to the power line rather than to the pulse.

(7) The relative heights of the pip deflections on the crt screen are proportional to the relative amplitudes of the corresponding frequency components being analyzed, within the limits of flatness of response of the spectrum analyzer in the range of 1 kc to 13.5 mc (to 23.5 mc with the SPA-3/25). The specified flatness of response (see Section I-5f) will be applicable only if neither SWEEP WIDTH nor IF BANDWIDTH are changed. Changing the setting of these two controls may change the height of crt deflections.

Best accuracy of amplitude ratio measurement is provided by the PWR (power) position of AMPLITUDE SCALE, least accuracy by the LOGarithmic position.

Note that it is permissible to exceed full-scale pip height to permit examination of low-level signals providing the equipment is not overdriven. See Section III-4b(3).

To observe signals of comparable amplitude, the AMPLITUDE SCALE switch should be set to LINear. The LINear scale of the crt screen is calibrated into ten divisions. The horizontal calibration lines are read at the right side of the screen.*

On the other hand, simultaneous examination of signals of wide divergence of amplitude will require the LOGarithmic setting of this switch. In this position, the calibration range is from 0 db to 40 db in 5-db divisions as indicated by the dots on the left side of the screen.* Note that the LOGarithmic calibration does not hold when narrow pulses are measured.

To measure power differences directly, use the PWR (power) position of the AMPLITUDE SCALE switch. Adjust the largest pip of interest to full scale. Relative deflections are approximately proportional to the square of the input voltage or power and are read on the LINear scale calibration. Should the lower pip measure 1/4 scale, the input voltage ratio is $1:\sqrt{4}$ or 1:2. The power calibration is accurate from 1.0 to 0.25 approximately; therefore, it is limited to a 4:1 full-scale power ratio. Note that the power scale deflection circuit includes a time constant which affects its accuracy at low tracing rates. For example, signal pip at slow sweep rates and narrow sweep widths should not be measured on the power scale.

Figure I-3 indicates the minimum frequency separation required to measure signals of unequal amplitude at various scanning velocities (scanning velocity being the product of sweep width and sweep rate). When there is a large difference in amplitude and the signals are close together, visual beats may interfere with measurement unless properly evaluated. To make the measurement, the center of the beat is used. This is illustrated in Figure III-5. The amplitude ratio in a is greater than that in b, resulting in a somewhat different presentation.

(8) If noise, beats between adjacent signals, etc. make observations difficult, the VIDEO FILTER can be used to suppress such unwanted effects. However, if measurements permit, it is better to keep the control in the OFF position and adjust the equipment for better resolution (see Section III-4d) to eliminate beats between adjacent signals.

Clockwise rotation of VIDEO FILTER increases the amount of filtering. Excessive filtering will decrease the amplitude of pips on the screen and worsen resolution. The control, if used, should be adjusted for clearest picture with

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* If so ordered, a calibrated screen can be supplied with horizontal lines for the logarithmic calibrations and dots for the linear calibrations.

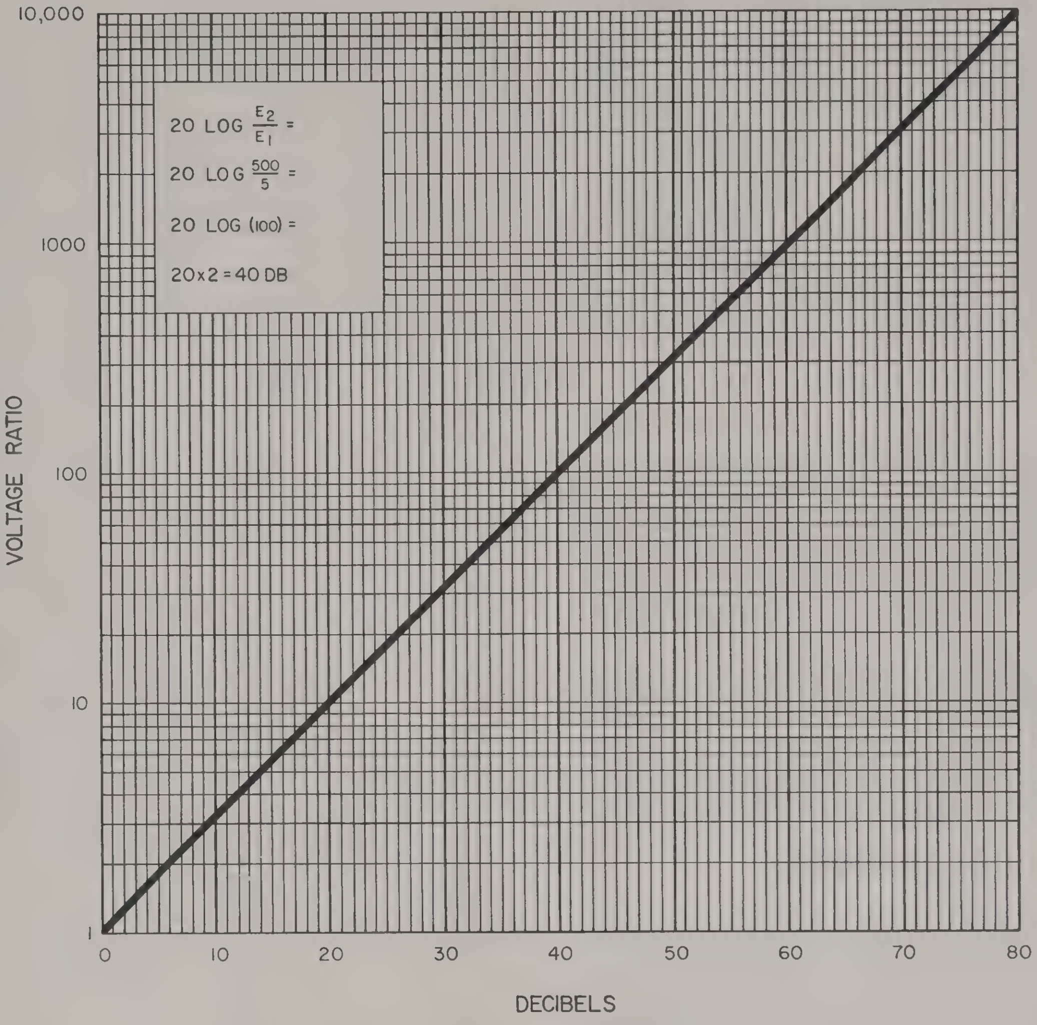


Figure III-4. Voltage Ratio - Decibel Conversion Chart.

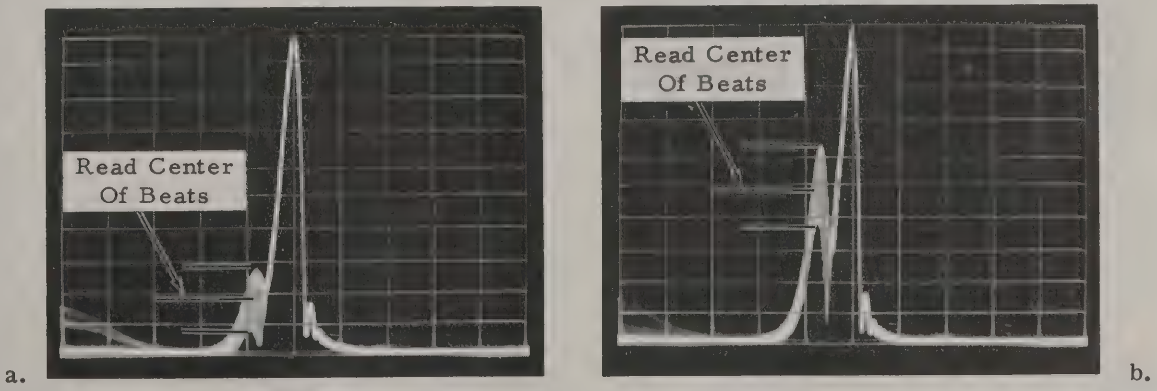
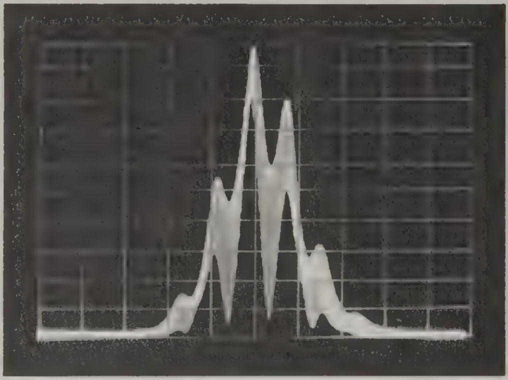
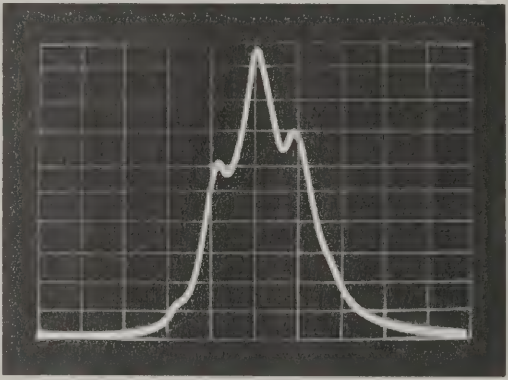

Read Center Of Beats
a.
Read Center Of Beats
b.

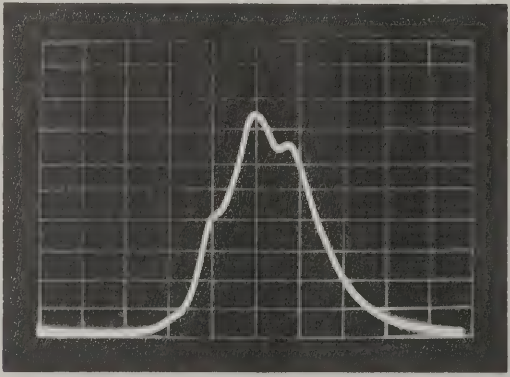
Figure III-5. Measurement of Closely Spaced Unequal Amplitude Signals.



a. Typical presentation. VIDEO FILTER in OFF position.



b. Suitable Degree of Filtering.



c. Excessive Filtering.

Figure III-6. Typical Screen Presentations Illustrating Adjustment of VIDEO FILTER Control.

minimum loss of amplitude. It should be noted that the control has greatest useful effect at low sweep rates. At high sweep rates, the effect on the signal pips is too great for the control to be helpful.

Figure III-6 shows typical screen presentations obtained when the VIDEO FILTER control is used. In "a" a typical case of beating between signals is illustrated. The control is in the OFF position. In "b" the control has been adjusted for a clear picture with minimum loss of amplitude. In "c" excessive filtering is illustrated. Note the loss of amplitude and broadening of the pips.

c. FREQUENCY MEASUREMENTS OF DISCRETE SIGNALS.

(1) Use the same technique for placing the signals to be studied on the crt screen as is given in III-4b. Since the pip shape is sharper on the LINear and PWR (power) than the LOGarithmic position of AMPLITUDE SCALE, the LINear and PWR (power) positions provide better frequency-measurement capabilities than does the LOGarithmic position.

(2) The CENTER FREQUENCY dial setting indicates the frequency of a pip at the center of the screen. (See III-4b(5) for a discussion of the ~~C(enter) F(requency) VERN(ier).~~ ZERO ADJ Adding the reading of the SWEEP WIDTH dial times the crt screen SWEEP WIDTH FACTOR calibration point (preserving sign) over which the pip appears to the reading of CENTER FREQUENCY dial represents the frequency of the component to which the pip corresponds. For example:

CENTER FREQUENCY Dial Reading = 10 MC
SWEEP WIDTH Dial Reading = 2 MC
Pip appears over -0.2 division on crt screen
Pip Frequency = 10 MC + (2 MC) x (-0.2) =
= 10 MC -0.4 MC = 9.6 MC

The internal frequency markers (~~500 kc and its harmonics~~) can be used to obtain more precise determinations of sweep width and center frequency than is possible with the calibrated dials.

(3) It should be noted that if frequency measurements of greater accuracy than that permitted by the calibration accuracy of the SWEEP WIDTH and CENTER FREQUENCY dials are required, a frequency-accurate signal may be connected to the INPUT of the spectrum analyzer to determine the exact location of interesting frequencies. To do this, it is first necessary to remove the signals being measured or isolate them properly. More conveniently, the Panoramic Signal Alternator, Model SW-1, may be used to alternate the test signal and the calibration signal at the input of the spectrum analyzer, thereby avoiding interference between the two and permitting an exact optical overlay of the two signals.

(4) If noise, beats between adjacent signals, etc. make observations difficult, the VIDEO FILTER can be used to suppress such unwanted effects. The technique of adjusting the VIDEO FILTER is given in III-4b(8).

d. MEASUREMENT OF SIGNALS CLOSELY SPACED IN FREQUENCY.

At full sweep width, test signals, or a carrier and its sidebands, having a small frequency difference, tend to have their corresponding deflections merge into and mask each other. The ability of the equipment to separate individual signals (resolution) depends upon two factors: the scanning velocity (product of sweep rate and sweep width) and the bandwidth of the intermediate-frequency section of the equipment. For any given scanning velocity, there is a complementary if bandwidth for optimum resolution.

The scanning velocity is diminished by increasing the sweep period (reducing the sweep rate) and/or decreasing the spectrum width scanned within a given time (reducing the sweep width). Reducing the scanning velocity improves resolution (improves the ability of the equipment to separate closely spaced frequency components.)

The IF BANDWIDTH control is used to adjust the intermediate-frequency-section bandwidth. Counterclockwise rotation of this control narrows the width of the if section. It should be noted that as this control is adjusted, there will be some degree of change in the sensitivity of the equipment. Narrowing the if bandwidth improves resolution until the point of optimum resolution (see III-4d(5). Beyond this point, further narrowing of i-f bandwidth worsens resolution.

Figure I-2 indicates resolution versus sweep width for various sweep rates. It should be used as a guide to determine whether or not a given set of signals can be resolved and, if they can, at what control settings. For example, if a given number of equal amplitude sidebands each a fixed frequency apart are to be measured, the product of number of sidebands times frequency separation determines the sweep width required. The frequency separation of the sidebands determines the poorest resolution that can be used and still have separation of the sidebands. Figure I-2 can then be used to determine the fastest sweep rate that will provide the necessary resolution at the required sweep width.

Figure I-3 is a graph which indicates the minimum frequency separation that is required to measure amplitude ratios E_2/E_1 at various scanning velocities (scanning velocity being the product of sweep rate and sweep width). If a signal of small amplitude is close in frequency to a signal of large amplitude, the pip due to the small signal will be influenced by the presence of the large pip. In effect, the small pip will ride on the skirt of the large pip (the amplitude-versus-frequency response of the intermediate-frequency section being bell-shaped). As the signals are separated in frequency, the error becomes less. The curves in Figure I-3 indicate the separation required for negligible error at the given scanning velocities.

To increase the resolution capabilities by reducing sweep width, narrowing the if bandwidth, and increasing scanning time, use the following procedure:

(1) Set the IF BANDWIDTH control completely clockwise, the position for the broadest if bandwidth.

(2) Adjust the CENTER FREQUENCY dial so that the desired band of signals is at the center of the screen.

(3) Spread the band of signals across the screen by turning the SWEEP WIDTH dial counterclockwise. Note that at reduced sweep width each frequency calibration mark of the screen represents a frequency separation equal to one-tenth of the reduced sweep width.

(4) Turn the IF BANDWIDTH control counterclockwise until individual signals are most clearly resolved. If the signals are not resolved, a slower sweep rate will have to be used. Optimum resolution can be recognized by the nature of the ringing pulses that will appear on the trailing edge of the signal pip as optimum resolution is approached. See Figure III-7 and subparagraph (5) below. Ringing can be seen more easily with the VIDEO FILTER control in the OFF position.

NOTE

Rotation of the IF BANDWIDTH control may result in increased or decreased pip height. Pip amplitude may be returned to suitable level with the STEP and CONTINUOUS INPUT ATTENUATOR controls. Turning the IF BANDWIDTH control counterclockwise after optimum resolution is reached will decrease the resolving power and result in greatly reduced sensitivity.

(5) Maximum resolution can be recognized by the presence of ringing pulses on the trailing edge of the pip.

Waveforms "a" to "f" of Figure III-7 indicate progressive variations in pip width ef-

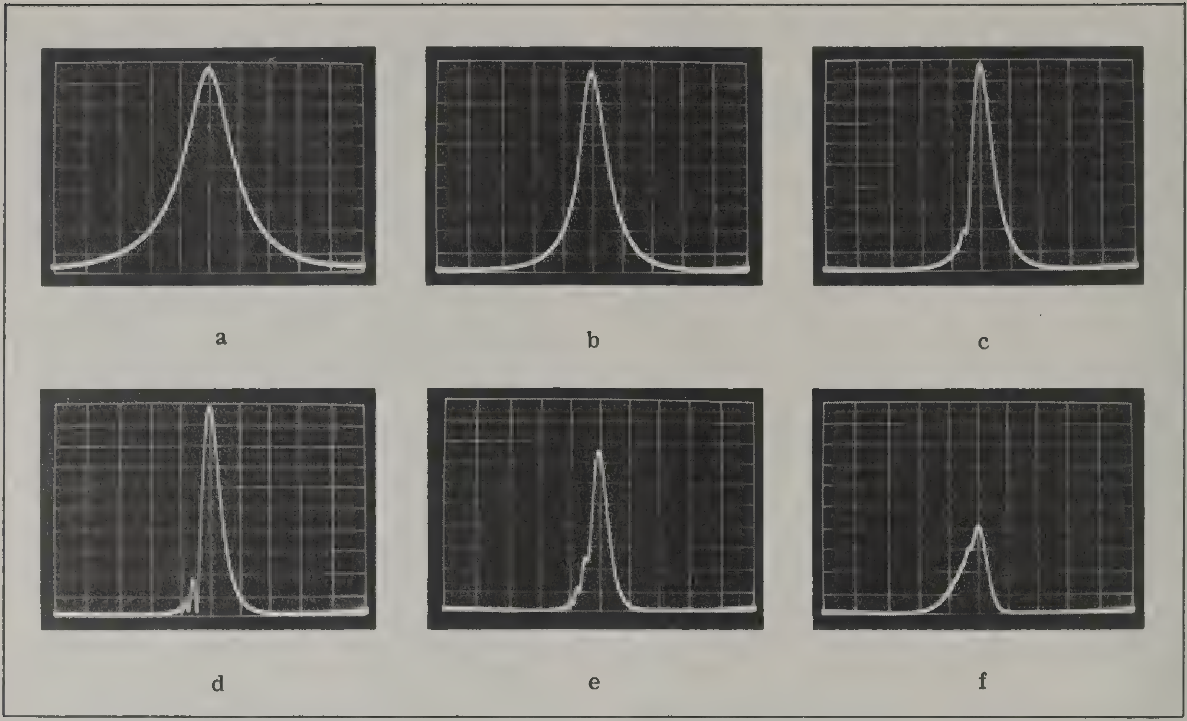


Figure III-7. Screen Presentations for Different Settings of IF BANDWIDTH Control.

fected by counterclockwise rotation of the IF BANDWIDTH control. In "a" and "b" the intermediate-frequency bandwidth is broad for particular scanning velocity (product of sweep rate and sweep width). Waveform "c" shows the beginning of ringing. On the LINear or PWR (power) amplitude scale, with a full-scale or smaller pip, the notch between the signal pip and the ringing pip nearest the signal pip extends into the baseline when the equipment is at optimum resolution. This is illustrated in waveform "d". On the LOGarithmic amplitude scale, with a greater than half-scale pip, the notch may not go to the baseline. In this case, optimum resolution is the point at which the notch is nearest the baseline. As the i-f section is made narrower, excessive ringing widens the signal pip and decreases the pip amplitude, thus reducing the resolving power. Further counterclockwise rotation of the IF BANDWIDTH control causes a reduction in amplitude and a tendency of remerging of the pips. This is shown in waveforms "e" and "f".

(6) To separate the signals better, the sweep width, i-f bandwidth, and/or sweep rate can be reduced further.

If it is mandatory to observe a given sweep width at one time and the signals contained therein are so closely spaced that they cannot be completely resolved, maximum resolution is recognized by the appearance of the clearest picture. Further counterclockwise rotation of the IF BANDWIDTH control will result in lessened resolution and a bobbing presentation. Better resolution can be obtained by looking at a narrower sweep width than that of interest; and then shifting the center frequency to cover the spectrum segment of interest.

e. NOISE ANALYSIS.

In noise analysis (noise being defined as randomly fluctuating signals), the same general techniques are used for setting the equipment for the spectrum of interest as are used for discrete signals.

If the input spectrum is broadband, to prevent equipment overload, it is very important to monitor the input level. See paragraph III-4b(3).

The following special techniques should be noted.

In general, a fairly wide i-f bandwidth is preferred for noise analysis. This permits relatively rapid scans since a wide if bandwidth gives better noise envelope averaging than does a narrow if bandwidth. However, if the noise source is highly selective (for example, influenced by a structural resonance), an if bandwidth which is narrow compared to the bandwidth of the resonance is required. This permits presentation of fine detail of the noise characteristics. When a narrow if bandwidth is used, a low sweep rate is necessary for correct amplitude presentation. The appropriateness of the sweep rate can be determined by changing the sweep rate slightly and noting whether or not there is any change in the envelope amplitude. (The portion of envelope having the greatest slope should be watched since the greatest change in envelope will occur here.) The sweep rate should be slow enough that a small change in sweep rate does not result in an amplitude change. If the sweep rate is at minimum, the sweep width should be reduced and/or the i-f bandwidth increased until it is possible to make a small change in sweep rate without changing the amplitude. Once a sweep which is slow enough to provide correct results has been established, a slower sweep can be set if improved envelope averaging is required.

In noise analysis, video filtering can be used to obtain averaging of the noise spectrum envelope. It is usually desirable to rotate the VIDEO FILTER control clockwise until a single-line presentation is obtained. The video filtering should not be too great (control too far clockwise) for the setting of IF BANDWIDTH. This can be checked by changing the sweep rate slightly and noting whether or not there is a change in the most sloped portion of the presentation.

In a general sense, the i-f bandwidth, VIDEO FILTER setting, sweep width, and sweep rate should be such that a slight change in sweep rate does not change the slope of the most sloped portion of the presentation. If this is not the case, it may be necessary to reduce the sweep rate, sweep width, or video filtering or increase the i-f bandwidth.

As an alternate to envelope averaging by video filtering, photographic averaging can be used. This is simply a matter of taking a composite photograph of a number of successive scans thereby obtaining an average presentation.

The equipment sensitivity listed in paragraph I-5e is applicable only to discrete signals. If absolute noise amplitude measurements are required, a calibration of the analyzer using a known noise amplitude should be made. Such a calibration must be made at the same scanning velocity (produce of sweep width and sweep rate) and if bandwidth used for measurement since change in scanning velocity and/or if bandwidth changes the amplitude. It is convenient to use the Panoramic Signal Alternator, Model SW-1, to display on alternate scans the calibration presentation and the analysis presentation.

Typical screen presentations with different control settings and different photograph exposure times of the same noise spectrum are shown in figure III-9. To obtain a convenient presentation amplitude, the input level and/or input attenuators have been adjusted as required.

In Figure III-8a the i-f bandwidth is narrow. The amplitude scale is linear. Since the scale is linear, the range of amplitude variation is emphasized compared to a logarithmic scale (see Figure III-9b). The use of a narrow i-f bandwidth also tends to emphasize the range of amplitude variation. The narrow bandwidth increases the likelihood of the equipment response at any given point being caused by a significantly higher or lower than average noise amplitude. If the i-f bandwidth is wide, it is more likely that the equipment response will be caused by a more typical noise amplitude. The result of using a wide i-f bandwidth and a logarithmic amplitude scale is illustrated in Figure III-9e.

Figure III-9c and d illustrate the use of extended photographic exposure to provide a better averaging of the noise spectra. Figure III-9c is an extended photograph (many scans) of the spectra photographed for one scan in 9a while 9d is an extended photograph of the spectra photographed for one scan in 9b.

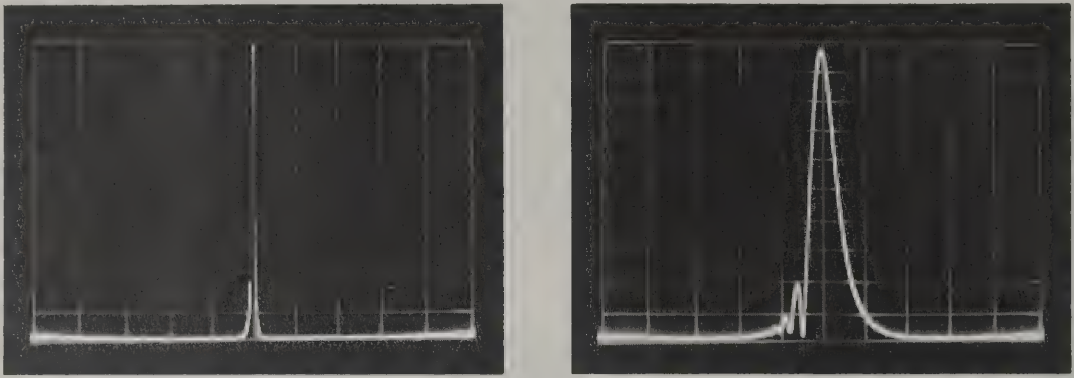
The use of video filtering to obtain averaging of the noise spectra is illustrated in Figures III-9f and g. With the equipment settings used for 9f, a slight change of sweep rate caused a significant change in the presentation, thus indicating the unsuitability of the settings. The sweep rate was reduced until no change in the presentation was noted. This is the correct response and is shown in Figure III-9g.

f. INTERPRETATION OF TYPICAL SCREEN PRESENTATIONS.

With a little experience, the operator will be able to recognize visually the character of the various types of signals.

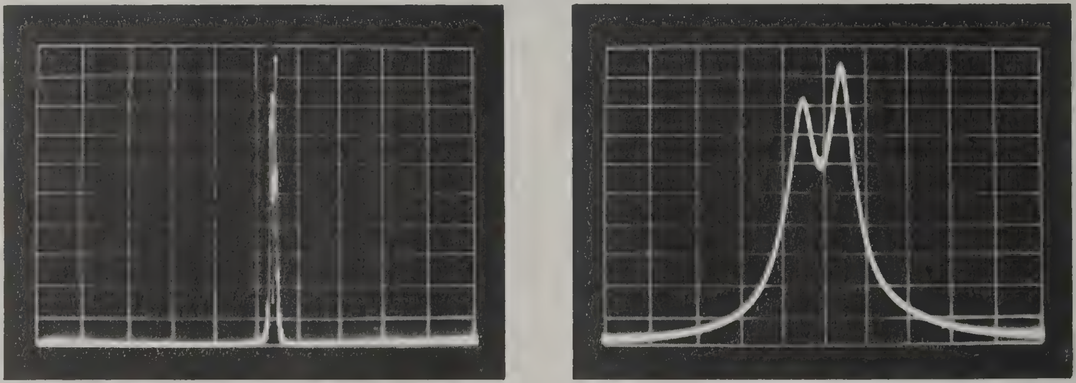
(1) An unmodulated constant signal appears as a pip of fixed height and fixed horizontal position. Reducing the sweep width widens the pip. See Figures III-8a and b.

Signal Interference. Two unmodulated constant signals which are close enough in frequency will appear as a single pip, varying in height as does an amplitude-modulated signal. Reducing the sweep width, reducing the sweep rate, and/or narrowing the if bandwidth may result in separation into two distinct pips. See Figures III-8c and d.



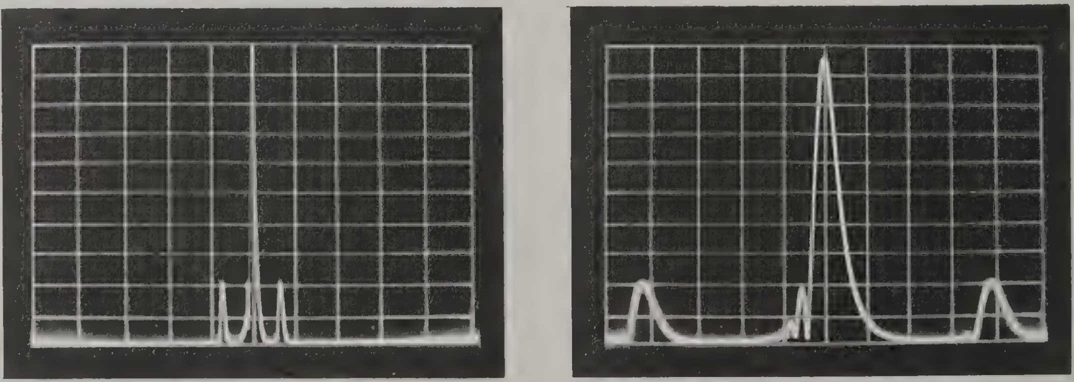
a. Constant carrier signal at approximately maximum sweep width.

b. Appearance of constant carrier at reduced sweep width.



c. Two interfering carriers depicted at maximum sweep width.

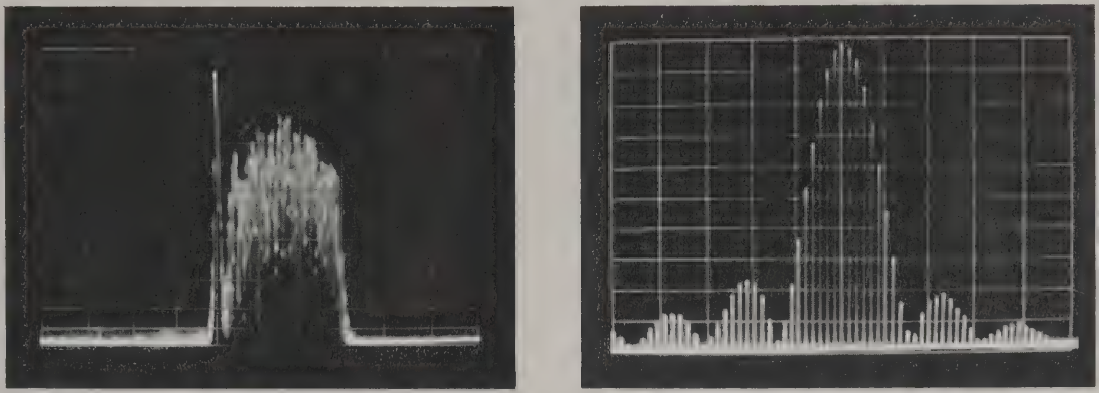
d. Same signals as in "c", sweep width reduced resulting in improved separation (resolution) of signals.



e. Amplitude-modulated signal showing carrier at the center and two sidebands.

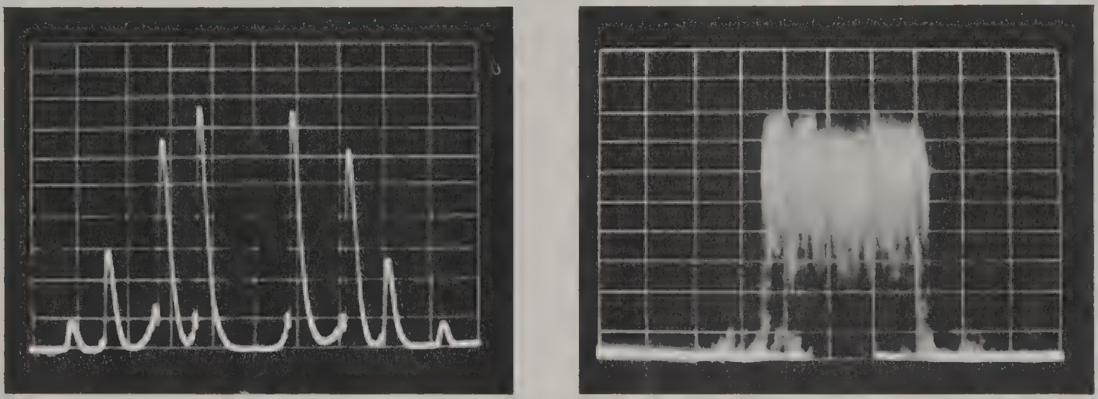
f. Same am signal as in "e" at reduced sweep width. Carrier remains at center of screen.

Figure III-8. Typical Screen Presentations For Discrete Signals.



g. Single-sideband signal without carrier suppression.

h. Spikes indicating distribution of a pulsed r-f signal.



i. Frequency-modulated signal with carrier null.

j. Typical sideband energy of fm signal, speech modulated. Slow sweep and/or extended exposure photography are used to display envelope averages.

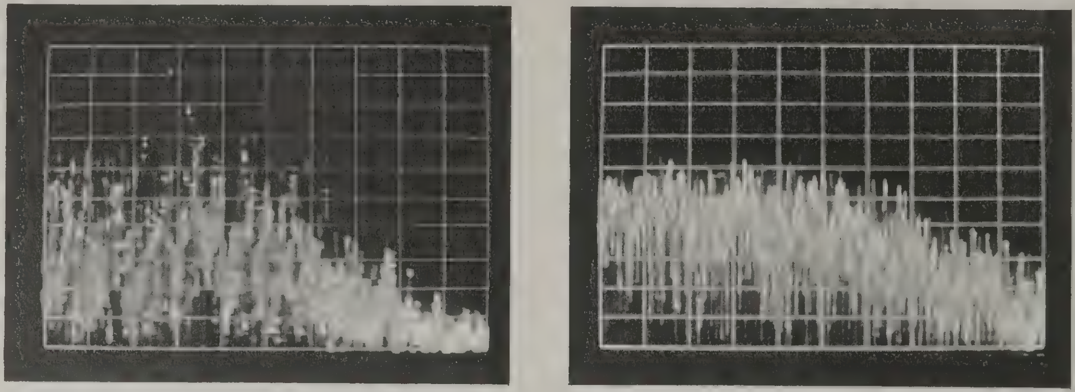
Figure III-8. (continued)

(2) An amplitude-modulated signal (see Figures III-8e and f) with a modulating frequency which is lower than the resolution capability of the equipment will appear as a deflection of variable height. Non-constant tone modulation of low frequency will produce a series of convolutions varying in height, their number being determined by the modulation frequency. The nature of the presentation will depend upon the sweep width, the sweep rate, and the bandwidth of the intermediate-frequency section.

As the modulation frequency increases, the convolutions move toward the two sides of the deflection and the sidebands tend to become visible. When the modulation frequency is increased, it becomes possible to separate the sidebands by reducing the sweep width, reducing the sweep rate, and/or narrowing the i-f bandwidth. The higher the frequency of modulation, the farther away those sidebands will move from the center deflections, representing the carrier. In evaluating the level of the sidebands, the flatness of response of the spectrum analyzer over the band of frequencies involved must be taken into account.

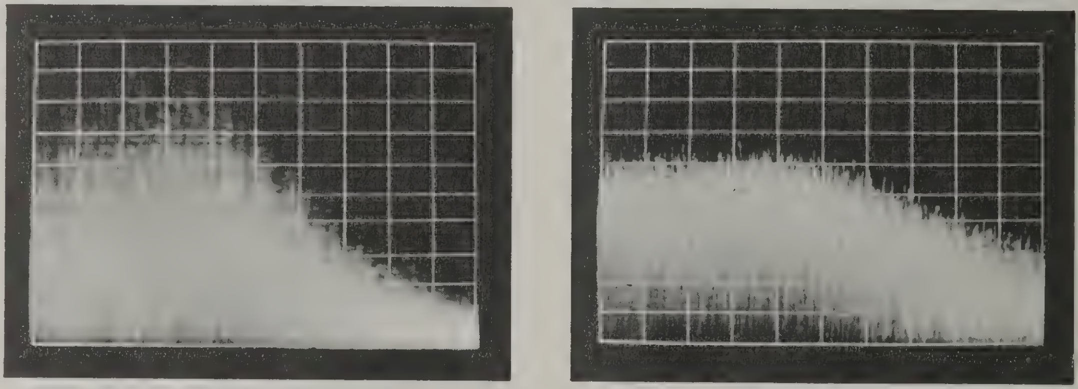
(3) A typical screen presentation of an amplitude-modulated single sideband signal without carrier suppression is shown in Figure III-8g.

(4) A pulse-modulated signal (see Figure III-8h) will consist of a pattern of vertical spikes. The number of spikes is dependent on the pulse repetition rate and the sweep rate of



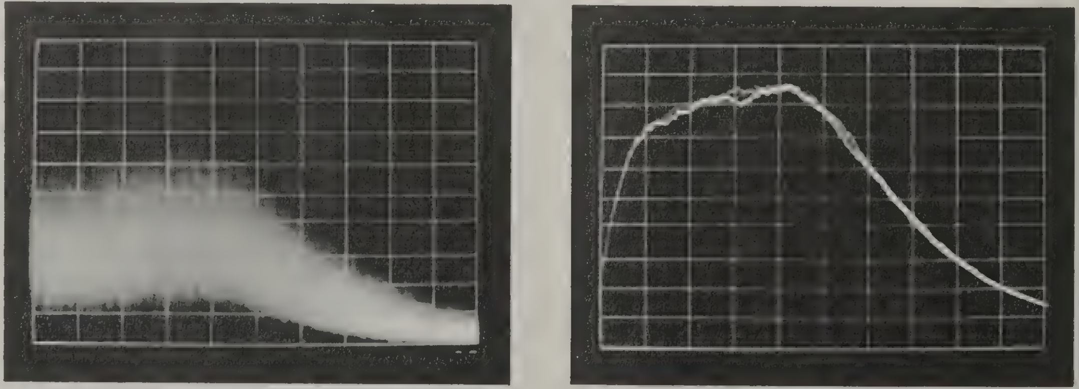
a. LINear Amplitude Scale. Narrow IF Bandwidth. One Scan.

b. Same as "a" on LOGarithmic Amplitude Scale. (Input attenuation adjusted for convenient amplitude presentation.)



c. Same as "a" with extended photographic exposure.

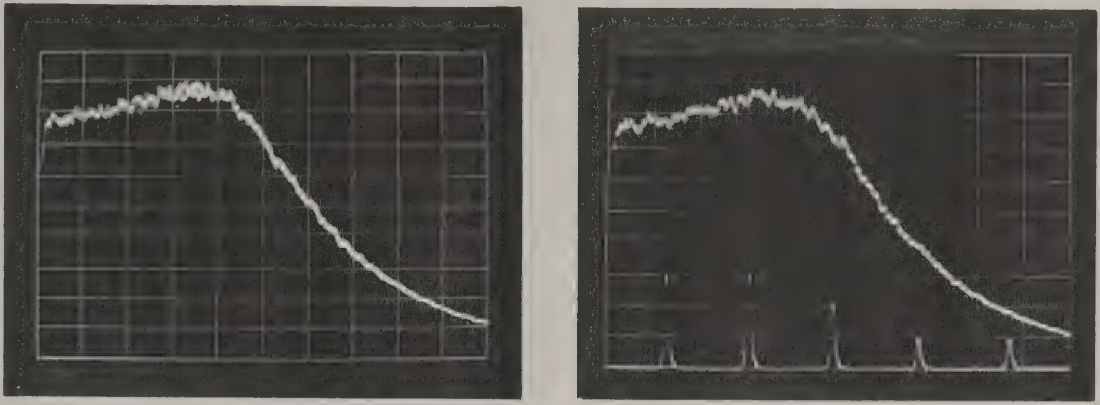
d. Same as "b" with extended photographic exposure.



e. LOGarithmic Amplitude Scale. Broad IF Bandwidth. One Scan.

f. Same as "e". Video filtering used to obtain single line presentation. Sweep rate too fast.

Figure III-9. Typical Screen Presentations For Noise Signals.



g. Same as "f" with sweep rate adjusted for correct presentation.

h. Same as "g" with marker presentation used to define frequency points.

Figure III-9. (continued)

the equipment. The amplitude of each spike represents the amount of energy present at that particular frequency during one of the pulses. The peak envelope of all the spikes represents the energy-distribution pattern of the signal. When analyzing this type of signal, both synchronous and asynchronous displays should be viewed in order to determine the complete pattern.

(5) Typical screen presentations of frequency-modulated signals are shown in Figures III-8i and j.

(6) Transient disturbances, generally examined, are of two types: periodic and aperiodic transients. Periodic transients, such as produced by motors, vibrators, buzzers, etc., appear as signals moving along the frequency-sweep baseline in one direction or another. Thus, an engine which is accelerating will produce a set of deflections which may move first in one direction, slow down, stop and then move in an opposite direction. This is caused by the fact that the analyzer is sweeping at a fixed rate, whereas the transient occurs at a variable rate. The images stand still on the screen when there is synchronism between the two. If the transient disturbance is synchronized with the analyzer horizontal sweep, the "noise" appears as a fixed signal which, however, does not move on the screen when the center frequency is changed, but only varies in height. Such deflections may appear like amplitude-modulated signals or like steady carrier. Aperiodic transients, such as static, appear as irregular deflections and flash along the whole frequency sweep axis.

(7) Diathermy or other apparatus using an unfiltered or ac power supply will produce a periodic disturbance which will cause a deflection to appear on certain portions of the screen and not appear on other portions when the analyzer horizontal sweep is synchronized with the power line. This is due to the fact that such equipment emits a signal pulsating in synchronism with power line. On the other hand, the analyzer, too, is sweeping the spectrum in synchronism with the line, but at a lower frequency and only when a proper phase relationship exists is it possible for the analyzer to receive those periodic pulses.

CHAPTER IV
THEORY OF OPERATION

IV-1. INTRODUCTION *

The Panoramic Spectrum Analyzer is a scanning heterodyne instrument which automatically provides a visual, two-dimensional display of the frequency components of a complex wave, in any selected 0- to 3-mc segment of the region between 200 cps and 15 mc (between 200 cps and 25 mc with the SPA-3/25). The display appears on the screen of long-persistence, flat-faced, cathode-ray tube, as vertical deflections distributed horizontally in order of component frequency. The frequency presentation is linear. The height of a given vertical deflection indicates the relative magnitude of its corresponding frequency component.

The spectrum analyzer consists basically of a calibrated input attenuator, an input cascode amplifier, a wide-band amplifier, a phase splitter, a sweeping oscillator, a balanced mixer, an intermediate-frequency-section attenuator, a 32-mc i-f amplifier, a 29.3-mc crystal oscillator, a second mixer, variably selective intermediate-frequency amplifiers (2.7 mc), a detector, vertical and horizontal deflection amplifiers, a sweep generator, and a cathode-ray-tube indicator.

In the balanced mixer, the sweeping-oscillator signal progressively heterodynes, in order of frequency, with those signals at the output of the phase splitter. Oscillator signal and even-order modulation products are balanced out in the mixer leaving only the input signal and sum and difference terms of the input and oscillator frequencies. Whenever the difference frequency is 32-mc, it is passed by the sharply tuned 32-mc intermediate-frequency section. The output of the 32-mc i-f section is mixed with the output of the 29.3-mc crystal oscillator.

The 2.7-mc product of this mixing passes through a 2.7-mc variable selective i-f section. The output voltage of the 2.7-mc i-f section is proportinal to the amplitude of the sampled portion of the input signal. This output is detected, amplified, and applied to the vertical deflection plates of the cathode-ray tube. The vertical deflection appears at a definite location along the horizontal axis according to signal frequency since a common sawtooth voltage source is used for both the sweeping oscillator and the horizontal deflection of the crt beam.

Oscillator sweep is obtained with a sawtooth-modulated circuit (consisting basically of a voltage-controlled tuning inductor) which controls the frequency of the swept oscillation. A calibrated SWEEP WIDTH control varies the amplitude of the modulating sawtooth to permit selection of any sweep width from 0 to 3 mc. A calibrated CENTER FREQUENCY control capacitively tunes the swept oscillator to permit selection of any center frequency between 0 and 13.5 mc (0 and 23.5 mc in the case of SPA-3/25).

IV-2. CIRCUIT DESCRIPTION, MODELS SPA-3 AND SPA-3/25, ANALYZER SECTION

a. INPUT CIRCUIT

The input circuit consists of an INPUT ATTENUATOR, an input cascode amplifier (V101), a wideband input amplifier (V102, and a phase splitter (V103).

The INPUT ATTENUATOR has two separate functions. A STEP function of 80 db attenuation in 20 db increments is provided by switches S501, S503 and S505. CONTINUOUS input attenuation is provided by varying R521. This control has a range of at least 20 db.

Input signal is directly connected to the INPUT type BNC connector (J501) if the signal is derived from a 72 ohm source. If the signal is derived from other than a 72 ohm source, matching pads are required or the signal may be connected to the INPUT connector through a cathode-follower probe (see Section VI-1).

The signal at the INPUT connector passes through the STEP INPUT ATTENUATOR switches and through the CONTINUOUS ATTENUATOR to the grid of V101B, part of the input cascode amplifier.

Output of the cascode amplifier is connected to the wideband amplifier (V102) which is connected to the phase splitter. Two outputs approximately 180° out of phase are produced by the phase splitter. These outputs are coupled to the control grids of V104 and V105.

Shunt peaking networks in the plates of V101, V102 and V103 improves the high frequency amplitude response of the input circuit.

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* Refer to Block Diagram (Figure IV-1) and Schematic Diagrams for supporting information.

b. FREQUENCY MARKERS. SEE ADD

Frequency markers, consisting of a 500-kc signal and its harmonics, are generated by a 500-kc crystal oscillator (V115A) and a cathode follower output amplifier (V115B). The parameters of the output amplifier were chosen for rich harmonic generation.

The MARKER AMPLITUDE control (R337, S104) forms the cathode resistor of the cathode follower. The control has a switch which, in the OFF position, removes B+ from the marker generator.

The marker output is coupled to the grid of one section of the phase splitter (V103).

c. SWEEPING OSCILLATOR.

The sweeping oscillator (V118) is a push-pull oscillator of the tuned-plate type. The frequency-discriminatory circuit of the oscillator consists basically of the secondary of a voltage-controlled tuning inductor (L127) and the CENTER FREQUENCY control (a dual tuning capacitor, C265 A, B).

The inductance of the secondary of the current-controlled tuning inductor depends upon the current applied to its primary. A linear sawtooth is applied to the primary. The inductance of the secondary varies with this sawtooth current, thus changing linearly from one inductance value to another inductance value and then snapping back to the original value. Thus the frequency of the oscillator changes linearly from one frequency to another frequency and then snaps back to the original frequency.

The sawtooth drive to the tuning inductor is derived from the sawtooth generator (V121). The maximum amplitude of sawtooth available to the tuning inductor and thus the maximum sweep width of the instrument is determined by the setting of the SWEEP LIMIT control (R421). Changing the setting of the front panel SWEEP WIDTH control (R349) changes the amplitude of the sawtooth current drive to the tuning inductor and thus the extent of inductance change and thus the extent of oscillator frequency change. The sawtooth voltage output from the SWEEP WIDTH control is amplified by a sawtooth amplifier (V117) and then connected to the tuning inductor. The mid-frequency of the oscillator is changed by changing the setting of the front-panel CENTER FREQUENCY control, a dual capacitor, which is part of the frequency-discriminatory circuit of the oscillator. A variable capacitor (C267) which is in parallel with one section of the CENTER FREQUENCY control serves as a ~~center-frequency vernier~~. MEANS FOR CALIBRATING CENTER frequency dial and ALSO CAN BE USED AS A TUNING CONTROL FOR VARIATIONS IN THE ORDER OF 200 KC OR LESS

As the center frequency is increased, the inductance change of the tuning indicator required for any particular fixed sweep width becomes less and less. A variable resistor, SWEEP WIDTH TRACK (R345), mechanically linked to the CENTER FREQUENCY control, reduces the sawtooth current drive to the tuning inductor as the center frequency is increased. This maintains a nominally constant sweep width as center frequency is changed. see add

The center-frequency range of the sweeping oscillator is set with L129 and C263 (the OSC TRIMMER). Variable inductance L129 is used to set the zero-frequency end of the CENTER FREQUENCY dial. The OSC TRIMMER is used to set the 13.5-mc end of the dial on the SPA-3 and is used to set the high-frequency end of the dial on the LO BAND on the SPA-3/25.

The temperature stability of the inductance of the current-controlled tuning inductor depends upon the current flow through the inductor. The BIAS control (R353) is used to set the center-frequency current flow for minimum inductance-versus-temperature drift thereby minimizing the center frequency-versus-temperature drift of the sweeping oscillator.

Output from the sweeping oscillator is coupled to the control grids of two oscillator output amplifiers (V119A, V119B). The output from V119A is coupled to the common cathode of the balanced modulator. The output from V119B is coupled to the G-6 OUTPUT connector which is located on the rear apron of the chassis. This connector provides the source of sweeping-oscillator signal necessary to drive the auxiliary Panoramic Companion Sweep Generator, Model G-6.

To provide a stable B+ voltage for the sweeping-oscillator section (V117, V118, V119), a voltage-regulating tube (V116) is used. see add

In the SPA-3/25, switch S106 (the BAND selector switch) selects parameters appropriate to the two center-frequency bands.

d. BALANCE MODULATOR.

The two out-of-phase outputs from V103A and V103B (the phase splitter) are coupled to the control grids of V104 and V105 (the balanced modulator), respectively. Sweeping-oscillator signal is coupled to common cathode of the two balanced-modulator tubes.

Sum and difference products of the mixing of the input signals with the sweeping-oscillator signal, as well as the input signals themselves, appear at the output of the balanced modulator. Sweeping-oscillator signal balances out in the output circuit of the balanced modulator. To

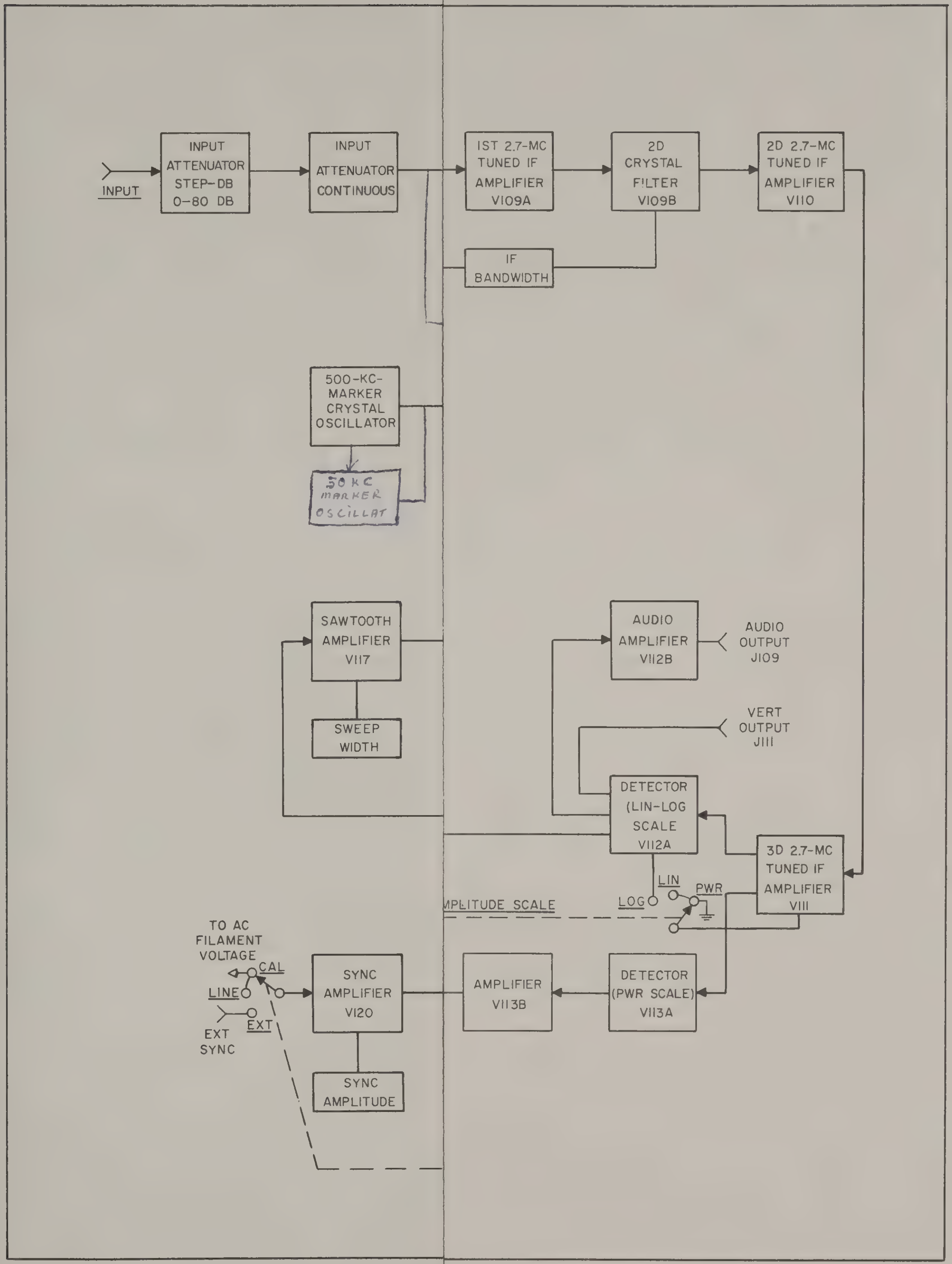
INPUT
INPUT ATTENUATOR STEP-DB 0-80 DB
INPUT ATTENUATOR CONTINUOUS
IST 2.7-MC TUNED IF AMPLIFIER V109A
2D CRYSTAL FILTER V109B
2D 2.7-MC TUNED IF AMPLIFIER V110
IF BANDWIDTH
500-KC-MARKER CRYSTAL OSCILLATOR
50 KC marker oscillat
SAWTOOTH AMPLIFIER V117
SWEEP WIDTH
AUDIO AMPLIFIER V112B
AUDIO OUTPUT J109
VERT OUTPUT J111
DETECTOR (LIN-LOG SCALE V112A
3D 2.7-MC TUNED IF AMPLIFIER V111
LIN
LOG
PWR
MPLITUDE SCALE
TO AC FILAMENT VOLTAGE
CAL
LINE
EXT
EXT SYNC
SYNC AMPLIFIER V120
SYNC AMPLITUDE
AMPLIFIER V113B
DETECTOR (PWR SCALE) V113A

Figure IV-1. Block Diagram, Analyzer Section.

b. FREQUENCY MARKERS. SEE ADD

Frequency markers, consisting of a 500-kc signal and its harmonics, are generated by a 500-kc crystal oscillator (V115A) and a cathode follower output amplifier (V115B). The parameters of the output amplifier were chosen for rich harmonic generation.

The MARKER AMPLITUDE control (R337, S104) forms the cathode resistor of the cathode follower. The control has a switch which, in the OFF position, removes B+ from the marker generator.

The marker output is coupled to the grid of one section of the phase splitter (V103).

c. SWEEPING OSCILLATOR.

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As the center frequency is increased, the inductance change of the tuning indicator required for any particular fixed sweep width becomes less and less. A variable resistor, SWEEP WIDTH TRACK (R345), mechanically linked to the CENTER FREQUENCY control, reduces the sawtooth current drive to the tuning inductor as the center frequency is increased. This maintains a nominally constant sweep width as center frequency is changed.

see add

The center-frequency range of the sweeping oscillator is set with L129 and C263 (the OSC TRIMMER). Variable inductance L129 is used to set the zero-frequency end of the CENTER FREQUENCY dial. The OSC TRIMMER is used to set the 13.5-mc end of the dial on the SPA-3 and is used to set the high-frequency end of the dial on the LO BAND on the SPA-3/25.

The temperature stability of the inductance of the current-controlled tuning inductor depends upon the current flow through the inductor. The BIAS control (R353) is used to set the center-frequency current flow for minimum inductance-versus-temperature drift thereby minimizing the center frequency-versus-temperature drift of the sweeping oscillator.

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To provide a stable B+ voltage for the sweeping-oscillator section (V117, V118, V119), a voltage-regulating tube (V116) is used. see add

In the SPA-3/25, switch S106 (the BAND selector switch) selects parameters appropriate to the two center-frequency bands.

d. BALANCE MODULATOR.

The two out-of-phase outputs from V103A and V103B (the phase splitter) are coupled to the control grids of V104 and V105 (the balanced modulator), respectively. Sweeping-oscillator signal is coupled to common cathode of the two balanced-modulator tubes.

Sum and difference products of the mixing of the input signals with the sweeping-oscillator signal, as well as the input signals themselves, appear at the output of the balanced modulator. Sweeping-oscillator signal balances out in the output circuit of the balanced modulator. To

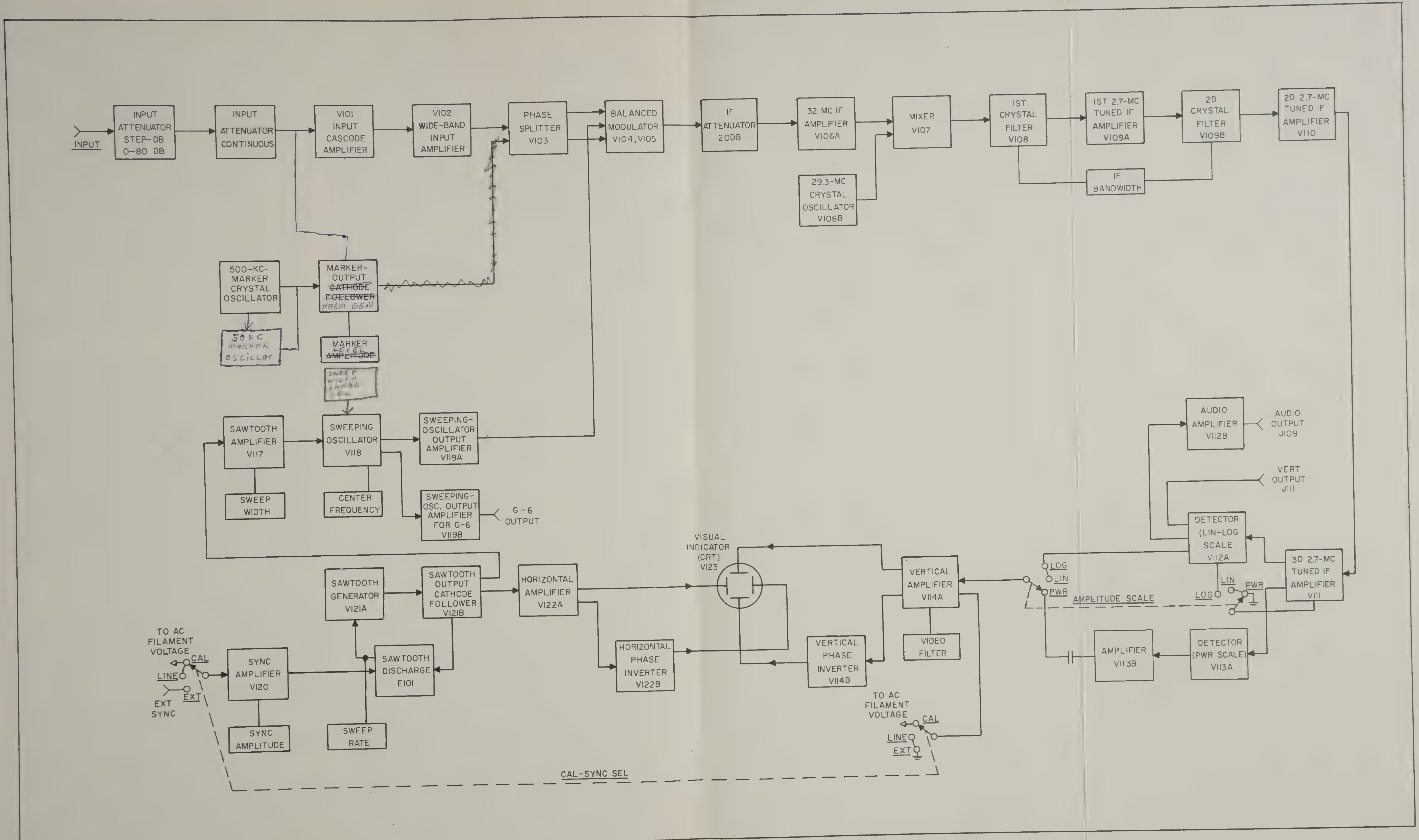

INPUT
INPUT ATTENUATOR STEP-DB 0-80 DB
INPUT ATTENUATOR CONTINUOUS
V101 INPUT CASCODE AMPLIFIER
V102 WIDE-BAND INPUT AMPLIFIER
PHASE SPLITTER V103
BALANCED MODULATOR V104, V105
IF ATTENUATOR 20DB
32-MC IF AMPLIFIER V106A
29.3-MC CRYSTAL OSCILLATOR V106B
MIXER V107
1ST CRYSTAL FILTER V108
1ST 2.7-MC TUNED IF AMPLIFIER V109A
IF BANDWIDTH
2D CRYSTAL FILTER V109B
2D 2.7-MC TUNED IF AMPLIFIER V110
500-KC-MARKER CRYSTAL OSCILLATOR
50 KC MARKER OSCILLAT
MARKER-OUTPUT ~~CATHODE FOLLOWER~~ HARM GEN
MARKER LEVEL ~~AMPLITUDE~~
SWEEP WIDTH RANGE
SAWTOOTH AMPLIFIER V117
SWEEPING OSCILLATOR V118
SWEEPING-OSCILLATOR OUTPUT AMPLIFIER V119A
SWEEP WIDTH
CENTER FREQUENCY
SWEEPING-OSC. OUTPUT AMPLIFIER FOR G-6 V119B
G-6 OUTPUT
AUDIO AMPLIFIER V112B
AUDIO OUTPUT J109
VERT OUTPUT J111
DETECTOR (LIN-LOG SCALE V112A
3D 2.7-MC TUNED IF AMPLIFIER V111
LOG
LIN
PWR
AMPLITUDE SCALE
LIN
LOG
PWR
AMPLIFIER V113B
DETECTOR (PWR SCALE) V113A
VISUAL INDICATOR (CRT) V123
VERTICAL AMPLIFIER V114A
VIDEO FILTER
VERTICAL PHASE INVERTER V114B
HORIZONTAL AMPLIFIER V122A
HORIZONTAL PHASE INVERTER V122B
SAWTOOTH GENERATOR V121A
SAWTOOTH OUTPUT CATHODE FOLLOWER V121B
SAWTOOTH DISCHARGE E101
SWEEP RATE
SYNC AMPLIFIER V120
SYNC AMPLITUDE
TO AC FILAMENT VOLTAGE
CAL
LINE
EXT
EXT SYNC
TO AC FILAMENT VOLTAGE
CAL
LINE
EXT
CAL-SYNC SEL

Figure IV-1. Block Diagram, Analyzer Section.

compensate for any unequalness in the balanced modulator tubes and circuitry, three controls are employed to maximize the cancellation of sweeping-oscillator signal. The front panel controls, A BALance and S BALance, have a differential effect on the output of the balanced modulator: A BALance by changing differentially the plate load of the balanced-modulator tubes and S BALance by changing differentially the screen voltages and thus the gain of the balanced-modulator tubes. Variable capacitor C131, a chassis control, is used to obtain suitable phase balance between the outputs of the two sections of the balanced modulator.

e. 32-MC INTERMEDIATE-FREQUENCY SECTION, 29.3-MC CRYSTAL OSCILLATOR, AND MIXER. SEE ADD

The 32-mc i-f section consists of three 32-mc bandpass filters (T101, T102, T103), an IF ATTENuator switch (S102), and an amplifier (V106A).

The balanced modulator output is connected to an intermediate-frequency section which is tuned sharply to 32 mc. Each time a 32-mc mixing product is produced in the balanced modulator, a pulse will pass through the 32-mc i-f section. This pulse corresponds to a particular input signal. All other frequencies are attenuated greatly. The front-panel control IF ATTENuator permits the selection of 0 db ~~or 20~~ TO 15 db of attenuation of the pulse which in effect is 0 db ~~or 20~~ TO 15 db of additional attenuation of the input signal. ~~The IF ATTEN ADJUST chassis control permits setting the IF ATTENuator control for correct attenuation.~~ The IF GAIN chassis control in the cathode of V106A permits adjusting the gain of this 32-mc i-f amplifier to set the input sensitivity of the analyzer.

The output from the 32-mc i-f section is mixed with the 29.3-mc crystal-controlled oscillator in V107. This mixer output consists of 2.7 mc and other outputs. They are fed to the input bandpass filter (T104) of the 2.7 mc variably selective i-f section.

f. 2.7 MC VARIABLY SELECTIVE INTERMEDIATE-FREQUENCY SECTION.

The 2.7 mc variably selective i-f section consists of a 2.7 mc bandpass filter (T104), a first 2.7 mc crystal-filter stage (V108, Y102), a first 2.7 mc tuned amplifier (V109A), a second 2.7 mc crystal filter stage (V109B, Y103), a second 2.7 mc tuned i-f amplifier (V110, T105), and a third 2.7 mc tuned i-f amplifier (V111, T106).

The input to the 2.7 mc i-f section is a bandpass filter tuned to 2.7 mc which passes 2.7 mc products appearing at the output of mixer V107 and greatly attenuates all other frequencies. The i-f signal passes through the five-stage i-f section (V108, V109A, V109B, V110, V111) which includes two identical 2.7 mc quartz-crystal filters (Y102, Y103). Associated with each crystal filter is an LC tuned circuit (C169, L111; C189, L117) and associated with each tuned circuit is one section of a dual potentiometer (R225A, R225B) which is the front-panel control IF BANDWIDTH. The bandwidth of the i-f section is determined by the bandwidth of the two combinations of tuned circuit and crystal filter. The bandwidth of the tuned circuits are determined by the setting of the IF BANDWIDTH control.

The frequency resolution, or ability to separate individual frequency components, is a function of the scanning velocity (frequency scanned per unit time) and the bandwidth of the intermediate-frequency stages.

The presence of "ringing" on trailing edge of the pip indicates that the equipment is close to or at optimum resolution. Assuming a fixed scanning velocity, the illustrations in Figure III-7 show the changes in the screen presentation of a single frequency input when the i-f bandwidth is made progressively narrower.

In (a) and (b), the i-f bandwidth is broad for the particular scanning velocity. (c) shows the beginning of "ringing". The extent of "ringing" in (d) indicates optimum resolution. Note that the "ringing" pip closest to the signal pip extends to the baseline. As the i-f section is made narrower, excessive "ringing" widens the pip and the signal pip amplitude decreases.

The output from the last (third) 2.7 mc tuned i-f amplifier (V111, T106) is connected to the LIN-LOG detector (V112) and the PWR detector (V113A).

In the LOGarithmic position of the AMPLITUDE SCALE selector switch, section S103A connects output from the LIN-LOG detector through the secondary of T105 to the grid of V111. This negative feedback, the amplitude of which is determined by the setting of the 0 DB LOG ADJ control (R279), causes the effective output of V111 to vary logarithmically with signal input. In the LINear and PWR (power) positions the point of connection of the feedback voltage is grounded and the output of V111 is linearly proportional to signal input. Section S103B of the AMPLITUDE SCALE switch changes the cathode bias of V111 and thus the gain of V111 appropriate for the three amplitude scales. In the LOGarithmic position of AMPLITUDE SCALE switch the 20 DB LOG ADJ control (R261) is used to adjust the cathode bias of V111 (and thus the gain of V111) such that a full-scale deflection on LINear and PWR (power) appears at the 20 db crt calibration point on the LOGarithmic position. The 20 DB LOG ADJ control sets the feedback amplitude for a 20 db difference in amplitude between a pip of 0 db deflection and a pip of 20 db deflection on the crt screen.

g. DETECTORS.

The 2.7-mc output from the i-f section is connected to the detector for the LINear LOGarithmic amplitude scale (V112), a triode whose plate and grid are connected to form a diode. The output from the detector is connected to section S103C of the AMPLITUDE SCALE selector switch.

The 2.7-mc output from the i-f section is also connected to the grid of V113A, the square-law detector for the PWR (power) amplitude scale.

The output from the square-law detector passes through an amplifier (V113B) to section S103C of the AMPLITUDE SCALE selector switch.

Switch selector S103C determines whether output from the LIN-LOG detector or the output from the square-law detector is connected to the grid of the vertical amplifier (V114A).

Output from the LIN-LOG detector is connected through the audio amplifier (V112B) to the AUDIO OUTPUT connector. This output connector permits aural monitoring when the equipment is set for zero sweep width.

h. VERTICAL PUSH-PULL AMPLIFIER.

The output from either the LIN-LOG detector or the amplified output from the square-law detector (selected by section S103C of the AMPLITUDE SCALE switch) is connected to the grid of the vertical amplifier (V114A).

An RC video filter is connected to the grid of the vertical amplifier. The resistive element of the filter is variable (R307, VIDEO FILTER). A switch (part of the VIDEO FILTER control) permits disconnection of the video filter from the circuit.

Output from the vertical amplifier is directly coupled to one vertical deflection plate of the cathode-ray tube and is connected to the vertical phase inverter and amplifier (V114B).

The output from the phase inverter (which is 180 degrees out-of-phase with the output from the vertical amplifier) is directly coupled to the other vertical deflection plate of the cathode-ray tube. The setting of the Vertical POSition control (R325) determines the cathode voltage and thus the plate voltage of V114B. This determines the vertical position of the crt beam.

In the CALibration position of the CALibration - SYNChronization SELector switch, switch section S105B connects heater voltage into the cathode circuit of the vertical phase inverter. This permits calibration of the sweep rate.

i. SAWTOOTH GENERATOR.

The sawtooth sweep voltage is derived from the sawtooth generator and sawtooth-output-cathode follower (V121) and E101 (an NE16 neon lamp). The pentode section of V121 acts as a Miller-type sweep generator. Resistors R401A (one section of the SWEEP RATE control) and R399 and capacitor C289 in the grid circuit provide a time constant which controls the negative-going voltage on the grid. This change in grid voltage is amplified in the pentode section and is fed back 180 degrees out-of-phase through the triode cathode-follower section of the same tube. This amplified positive-going voltage tends to slow down the rate of negative change of the grid of the pentode section. This results in a linear, positive sawtooth voltage at the output of the cathode follower. When this voltage reaches a pre-determined amplitude, E101 conducts restoring the grid of the pentode section of the V121 to its initial condition. (The conduction time for E101 is the retrace time of the sawtooth.)

R401B (the other section of the SWEEP RATE control), which is in the crt negative voltage bleeder string, determines the level of the negative-going voltage applied to the grid of the pentode section of V121. This negative-going voltage determines the amplification of the pentode section of V121 which in effect amplifies the time constant.

When the negative grid bias voltage of the pentode section of V121 is at a minimum, the amplification of the time constant will be the greatest. At the same time, the second section of the dual potentiometer is at greatest resistance or highest time constant. Rotation of the SWEEP RATE control in a clockwise direction results in a higher sweep rate. In the fully clockwise position, the sweep rate is approximately 60 cps. In the fully counterclockwise position, the sweep rate is approximately 1 cps.

To synchronize the sawtooth generator, the differentiated output from the sync amplifier is connected through the SYNChronization AMPlitude control to the conductive coating of E101.

The electrostatic effect of voltage pulses appearing on this coating will change the voltage required to cause E101 (the sawtooth discharge tube) to conduct. A pilot lamp, DS101, is located adjacent to E101. The function of DS101 is to maintain a constant ionization level in E101 by photo-electric effect, thereby maintaining a constant conducting voltage. (If DS101 is not lit, erratic operation of the sweep circuit may occur.)

In the CALibration or LINE position of the CALibration-SYNChronization SELector switch, switch section S105A connects ac heater voltage to the grid of the sync amplifier (V120) thereby synchronizing the sawtooth generator to the power line.

The EXTernal position of the CALibration-SYNChronization SELector permits synchronization with external voltages which may be connected to the EXTernal SYNChronization connector (J125).

Turning the SYNChronization AMPlitude control completely counterclockwise removes synchronizing voltage from E101 allowing the sawtooth generator to be free running.

The output from the sawtooth generator is connected to both the sweeping oscillator (see IV-2C) and the horizontal push-pull amplifier.

To provide a sawtooth voltage of zero average dc level, a negative voltage, whose level is determined by the setting of the CF BALance control (R311), is connected at the output of the sawtooth generator to cancel the normally positive average dc level of sawtooth output. This permits correct baseline centering.

j. HORIZONTAL PUSH-PULL AMPLIFIER.

Sawtooth voltage derived from V121B is connected to the grid of the horizontal amplifier (V122A). Output from the horizontal amplifier is directly coupled to one horizontal deflection plate of the cathode-ray tube. The setting of the Horizontal POSition control (R431) determines the cathode bias and thus the plate voltage of V121A. This determines the horizontal position of the crt beam.

Output from the horizontal amplifier is also connected to the horizontal phase inverter and amplifier (V122B). The output from the phase inverter (which is 180 degrees out-of-phase with the output from the horizontal amplifier) is directly coupled to the other horizontal deflection plate of the cathode-ray tube.

The LINE SIZE control (R415) determines the level of sawtooth connected to the horizontal amplifier and thus the extent of the horizontal deflection of the crt beam. When an external sweep source is used, the EXTernal LINE SIZE control (R417) is adjusted such that the same baseline length is obtained with either the internal sawtooth generator or the external sweep-voltage generator.

Sawtooth from V122A is connected to the SYNChronization PULSE OUTput receptacle (J130) through an RC differentiating circuit which shapes the sawtooth wave into a sharp pulse. This pulse may be used to synchronize to the spectrum analyzer sweep, the Panoramic Signal Alternator Model SW-1, camera shutters, and/or auxiliary indicators.

k. VISUAL INDICATOR.

A type 5ADP7 cathode-ray tube is used as a visual indicator. A voltage-doubler high-voltage system is used to drive the crt. Negative high voltage is connected to the electron gun. Positive high voltage is connected to the post accelerator anode. The FOCUS and BRILLIANCE controls are located in the negative high voltage bleeder string. The ASTIGmatism control is used to adjust the crt trace for uniform focus.

l. ACCESSory EQUIPment Receptacle and Shorting Plug.

The ACCESS EQUIP receptacle (J129) is provided to permit the convenient connection of accessory equipment to the spectrum analyzer. The shorting plug (P129) must be connected when normal operation is required.

When the shorting plug is connected, the jumper wire between contacts G and F connects the sawtooth generator (V121) to B+. The jumper wire between contacts D and A connects the output of the sawtooth generator to the sweeping-oscillator and horizontal circuits.

When the shorting plug is disconnected, the internal sawtooth generator is turned off. A 250-v regulated B+ supply is available at contact F. A -85-v regulated B- supply is available at contact H. An external sweep source may be connected at contact B. Contact C is a ground connection. Contact J provides detected vertical output.

IV-3. CIRCUIT DESCRIPTION, MODEL PS-19

The Power Supply, Model PS-19 furnishes all necessary power for the analyzer section at the indicated contact of connector J7 as follows:

(1) +250-v dc, regulated - Contact H
(2) -1650-v dc - Contact L
(3) +1650-v dc - Contact N
(4) -85-v dc, regulated - Contact D
(5) 6.3-v ac - Contacts P-M
(6) 6.4-v ac - Contacts A-B
(7) 6.3-v ac - Contacts E-F

Note: Dc voltages are from contact to chassis. Ac voltages are between indicated contacts.

The power input to the Model PS-19 is derived from a constant-voltage transformer which provides a stable source of 115-v, 60-cps power when connected to a 60-cps power source (95-130v). (Constant-voltage transformers for other power sources are available on special order.)

The +250-v dc is provided by a full-wave rectifier (V1). Filtering is introduced by C5 and C7. Regulation is accomplished by V2, V3, V4, V5 and V6. The voltage-regulator tube (V6) provides a reference voltage for the regulator-control tube (V5). The regulator-control tubes serve as a dc amplifier which amplifies and feeds back to the grids of the series regulator (V2, V3) and voltage change in the +250-volt line. This feedback changes the cathode-to-plate voltage drop across V2, V3 so as to oppose the change in the +250-volt line. The +250 Volt ADJust control (R39) is used to set the grid voltage of V5B so that regulation produces a nominal voltage of +250-v dc.

Negative high voltage for the cathode-ray tube is provided by a half-wave rectifier (CR3). Filtering is introduced by R51 and C19A, B.

Positive high voltage for the cathode-ray tube is provided by a half-wave rectifier (CR5). Filtering is introduced by R57 and C21A, B.

The -85-v dc supply is provided by a half-wave rectifier (CR1). Filtering is provided by C15, R47 and C17. V7 serves as a voltage regulator for the negative supply.

CHAPTER V
SERVICE AND MAINTENANCE

This chapter is divided into five sections to facilitate its use in connection with adjustment, repair, or alignment of the equipment.

Section V-1 is a guide to trouble shooting. The trouble-shooting chart lists principal trouble symptoms and their corrective measures. As an aid to trouble-shooting, a voltage and resistance chart and a stage-gain chart are provided.

Section V-2 outlines the nature of the touch-up alignment that may become necessary because of aging or replacement of any of the tubes (and/or associated components) of the equipment.

Section V-3 indicates the functions of the service controls and components.

Section V-4 is a complete field alignment procedure. It is only under the most unusual circumstances that this procedure will have to be used in its entirety. Most of the alignment problems encountered in the field can be solved by using the applicable adjustment techniques suggested in Section 2.

Section V-5 is a final testing procedure used to determine whether the equipment is within specifications after it has been repaired.

V-1. TROUBLE SHOOTING

This section is a guide to trouble shooting the equipment. The trouble-shooting chart, voltage and resistance chart, and the stage-gain chart are used to localize the fault to the defective stages and components responsible for the abnormal condition.

a. TROUBLE-SHOOTING CHART

This chart lists the principal trouble symptoms which may be observed while making tests. For each symptom, corrective measures are indicated. When a check of a tube is listed, the tube and its associated circuitry should be investigated. The voltage and resistance chart and the stage-gain chart can be used to help pin-point the cause of trouble.

SYMPTOM	CORRECTIVE MEASURES
1. No scale illumination. Not corrected by adjusting scale ILLUMination control.	1. Check power connections. Check 3 ampere fuses (F1, F2). Check output voltage from constant-voltage transformer. Low output may be caused by defective constant-voltage transformer, or by a short circuit in the power supply or analyzer.
2. 3-ampere fuse (F1, F2) fails when replaced.	2. Check T1, T2 and their loads. If fuse fails immediately, check for shorted power transformer. Check for ac filament short. If fuse fails after approximately 30 seconds, check for B+ short.
3. No crt illumination. Not corrected by adjustment of FOCUS and BRILLIANCE control.	3. Check seating of anode contact of crt. Check seating of shorting plug in ACCESS EQUIP. receptacle. If removal of V111 from its socket results in crt illumination, check intermediate-frequency section for oscillation and swept oscillator section for failure. Check high voltage. If high voltage incorrect, check CR3, CR5, and associated filter circuits.

SYMPTOM	CORRECTIVE MEASURES
	Check V121 (including neon lamp E101, mounted under the chassis) and V122. Note that the mid-point of the sawtooth swing should be approximately the same at the two horizontal deflection plates of the crt. Check V114. Note that there should be an approximately 60 volt difference between the two vertical deflection plates of the crt. Check V123.
4. Crt illumination observed but baseline not obtained. (Stationary dot on crt screen.)	4. Check seating of shorting plug in ACCESS EQUIP. receptacle. Check B+ at J5, +250 V TEST. If necessary, adjust +250 V ADJUST. Check V1 to V6. Check V121 (including neon lamp E101, mounted under the chassis) and V122.
5. Baseline length and/or horizontal position incorrect. Not corrected by turning SYNC AMPlitude counterclockwise.	5. If baseline too long and sensitivity too great, check for insufficient high voltage. If high voltage incorrect, check CR3, CR5, and associated filter circuits. Check V121 (including neon lamp E101, mounted under the chassis and V122. Reset LINE SIZE, Horizontal POSition and CF BAL per V-2b(7).
6. Baseline cannot be synchronized.	6. Check that lamp DS101 (under the chassis near E101) is lit. Check V120.
7. SWEEP RATE control does not vary the sweep rate from 1 cps to 60 cps.	7. Check V121 (including neon lamp E101, mounted under the chassis).
8. No signal pips appear on the screen. Marker pips do not appear. Zero-frequency pip does not appear when CENTER FREQUENCY is set to 0 (may require adjustment of A and/or S BALance).	8. Check input stage (V103), balanced modulator (V104, V105), i-f stages (V106, V107, V108, V109, V110, V111), and sweeping oscillator (V116, V117, V118, V119). Use stage gain chart to help isolate failure.
9. Zero-frequency pip cannot be balanced.	9. Adjust C131 per V-2b(2). Check V104, V105.
10. No signal pips appear on crt screen. Zero-frequency pip appears when CENTER FREQUENCY is set to 0 (may require adjustment of A and/or S BALance).	10. Check connections between signal source and input to analyzer. Check that attenuators, SWEEP WIDTH, and CENTER FREQUENCY are correctly set for level and frequency of input signals. Check V101, V102, V103.

SYMPTOM	CORRECTIVE MEASURES
11. Marker pips do not appear on crt screen. Signal pips do appear.	11. Check V115 (including Y104).
12. Insufficient signal sensitivity.	12. Check signal channel from crt to input V123, V114, V112A, V111, V110, V109, V108, V107, V106, V105, V104, V103, V102, V101). Check sweeping oscillator output V119A.
13. LINear amplitude scale calibrations incorrect.	13. Check V112A.
14. LOGarithmic amplitude scale calibrations incorrect.	14. Check V111, V112A.
15. PWR (power) amplitude scale does not function correctly.	15. Check V113.
16. The pip height of a constant amplitude signal varies more than ±15% as the frequency is varied from 1 kc to 13.5 mc (to 23.5 mc with the SPA-3/25 with AMPLITUDE SCALE set to LINear.	16. Check V101, V102, V103, V104, V105. Check V118, V119.
17. INPUT ATTENUATOR, STEP functions incorrectly.	17. Check resistors and capacitor associated with switch S501, S503, S505.
18. INPUT ATTENUATOR, CONTINUOUS has incorrect range.	18. Check the following resistors and capacitor. R519, R521, R523 and C505.
19. Switching IF ATTENuator from 0 DB to 20 DB does not provide 20 db of attenuation.	19. Reset IF ATTEN ADJ for 20 db of attenuation.
20. SWEEP WIDTH and CENTER FREQUENCY dial calibrations incorrect.	20. Check V116, V117, V118, V119.
21. SWEEP WIDTH dial calibrations incorrect. CENTER FREQUENCY dial correct.	21. If sweep width is insufficient and baseline too short, check V121 (including neon lamp E101, mounted under the chassis). Reset LINE SIZE, Horizontal POSition and CF BAL per V-2b(7). Reset SWEEP LIMIT control and/or R342 (SPA-3/25 only) per V-2b(5). Check V117, V118.
22. Sweep width changes more than ±15% as CENTER FREQUENCY control is changed from 0 to 13.5 mc (to 23.5 mc in the case of SPA-3/25).	22. Check the gearing associated with the CENTER FREQUENCY control (variable capacitor). If this gearing has loosened, see V-4d(1). Redetermine value of R341 per V-2b(8) (SPA-3). Redetermine values of R343 and R344 per V-2b(9) (SPA-3/25).
23. CENTER FREQUENCY dial calibrations incorrect. SWEEP WIDTH dial correct.	23. Check V118. Adjust L129 and OSC TRIMMER per V-2b(6).

SYMPTOM	CORRECTIVE MEASURES
24. Resolution poor.	24. Check crystals Y102, Y103. NOTE: If it is necessary to replace the crystals, the replacement crystals should be obtained in matched pairs from Panoramic Electronics, Inc.
25. Range of resolution incorrect. (If bandwidth cannot be made broad enough.)	25. Check V108 and V109B. Realign crystal-filter circuits per V-2b(3).

b. VOLTAGE-RESISTANCE CHARTS.

The charts were made with the Analyzer, Power Supply and Constant-Voltage Transformer interconnected for normal operation.

Unless otherwise specified, all voltage and resistance values were taken between the indicated point and chassis ground. All readings were made with an RCA VTVM Model WV-77B.

The following front-panel control settings were used.

SWEEP WIDTH	3 MC
CENTER FREQUENCY	0
IF BANDWIDTH	MAXimum
AMPLITUDE SCALE	LINear
IF ATTENuator	20 DB
INPUT ATTENuator	0 DB
MARKER	ON (largest pip full scale)
VIDEO FILTER	OFF
SWEEP RATE	30 CPS

c. STAGE GAIN CHART, TABLE V-1.

The stage gain chart is used as a standard to check the gain of each stage when troubleshooting.

Set the front-panel controls as follows:

SWEEP WIDTH Dial	MAX
CENTER FREQUENCY Dial	2 MC
IF BANDWIDTH	MAXimum
IF ATTENuator	0 DB
AMPLITUDE SCALE	LINear
INPUT ATTENuator (CONT)	0 DB
INPUT ATTENuator (STEP)	0 DB
VIDEO FILTER	OFF

The stage gain chart was made using a Measurements Corporation Standard Signal Generator, Model 82, with a Microlab 50-72 ohm matching pad and RG59/U coaxial cable terminated with 75 ohms. This is illustrated in Figure V-1.

Unless otherwise indicated, the listed input voltages are required for full scale deflection on the screen of the Spectrum Analyzer.

For INPUT measurement, use RG59/U cable with BNC Type connectors at each end.

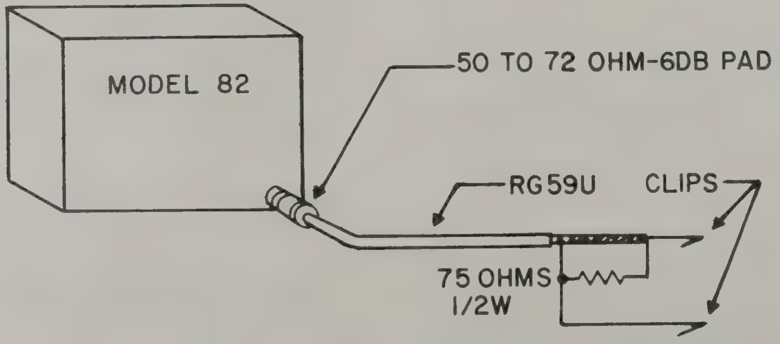


Figure V-1. Stage Gain Measurement Circuit.

25

A

7	8		9	
R	V	R	V	R
41K	115	42K	0	0
0	–	–	–	–
2.2K				
100K	215	16K	0	0
60K	215	16K	0	0
12	175	40K	210	16K
22				
490				
3.8	72	85K	250	11K
0				
200				
200				
200				
110K	0.4	123	0	0
320K	0.9	4.7K	0	0
140K	16	5.6K	0	0
140K	16	5.6K	0	0
470K	0	0	0	0
NC				
13K	150	13K	3	160
51K	0	0	0	0
240				
1M	2.2	3K	0	0
0	130	24K	125	480K
160K	4	5.2K	0	0
240K	135	200K	165	35K

12	13		14	
R	V	R	V	R
NC	NC	NC	−1750	1.7M

P

7	8		9		CAP	
R	V	R	V	R	V	R
NC	460	□				
∞	NC	NC			460	□
∞	NC	NC			460	□
1.7M	80	240K	⊗	∞		
50	240K	⊗	∞			
NC						
45K						

SYMPTOM	CORRECTIVE MEASURES
24. Resolution poor.	24. Check crystals Y102, Y103. NOTE: If it is necessary to replace the crystals, the replacement crystals should be obtained in matched pairs from Panoramic Electronics, Inc.
25. Range of resolution incorrect. (If bandwidth cannot be made broad enough.)	25. Check V108 and V109B. Realign crystal-filter circuits per V-2b(3).

b. VOLTAGE-RESISTANCE CHARTS.

The charts were made with the Analyzer, Power Supply and Constant-Voltage Transformer interconnected for normal operation.

Unless otherwise specified, all voltage and resistance values were taken between the indicated point and chassis ground. All readings were made with an RCA VTVM Model WV-77B.

The following front-panel control settings were used.

SWEEP WIDTH	3 MC
CENTER FREQUENCY	0
IF BANDWIDTH	MAXimum
AMPLITUDE SCALE	LINear
IF ATTENuator	20 DB
INPUT ATTENuator	0 DB
MARKER	ON (largest pip full scale)
VIDEO FILTER	OFF
SWEEP RATE	30 CPS

c. STAGE GAIN CHART, TABLE V-1.

The stage gain chart is used as a standard to check the gain of each stage when troubleshooting.

Set the front-panel controls as follows:

SWEEP WIDTH Dial	MAX
CENTER FREQUENCY Dial	2 MC
IF BANDWIDTH	MAXimum
IF ATTENuator	0 DB
AMPLITUDE SCALE	LINear
INPUT ATTENuator (CONT)	0 DB
INPUT ATTENuator (STEP)	0 DB
VIDEO FILTER	OFF

The stage gain chart was made using a Measurements Corporation Standard Signal Generator, Model 82, with a Microlab 50-72 ohm matching pad and RG59/U coaxial cable terminated with 75 ohms. This is illustrated in Figure V-1.

Unless otherwise indicated, the listed input voltages are required for full scale deflection on the screen of the Spectrum Analyzer.

For INPUT measurement, use RG59/U cable with BNC Type connectors at each end.

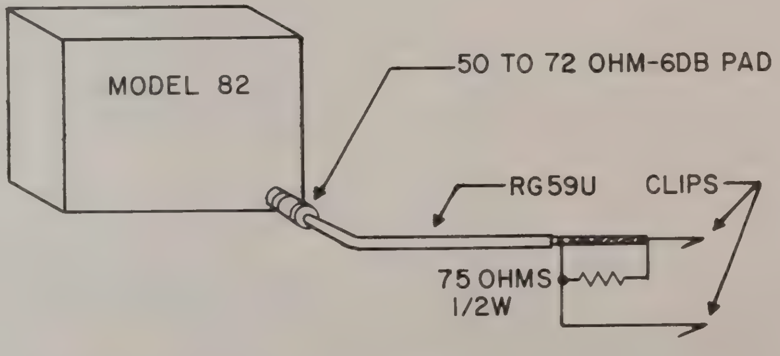


Figure V-1. Stage Gain Measurement Circuit.

VOLTAGE AND RESISTANCE CHARTS MODELS SPA-3 & SPA-3/25

ANALYZER

CIRCUIT REF. SYMBOL	TYPE	PIN NUMBERS 1		2		3		4		5		6		7		8		9	
		V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R
V101	6BQ7	115	42K	-1.7	100K	0	0	0	0	5.2VAC	*	210	8K	115	41K	115	42K	0	0
V102	6CB6	165	483K	0	0	5.2VAC	*	0	0	203	8.5K	140	39K	0	0	–	–	–	–
V103	6J6	205	12K	210	12K	0	*	5.2VAC	*	37	102K	37	102K	40	2.2K				
V104	5879	0	200K	NC	NC	0.7	900	5.2VAC	*	0	0	NC	NC	20	100K	215	16K	0	0
V105	5879	0	200K	NC	NC	0.7	900	0	0	5.2VAC	*	NC	NC	20	60K	215	16K	0	0
V106	6AW8A	0	0	-2.1	100K	165	35K	5.2VAC	*	0	0	6.8	1.6K	0	12	175	40K	210	16K
V107	6BE6	-1.7	4K	1.4	220	5.2VAC	*	0	0	240	16K	55	50 K	0	22				
V108	6AB4	240	12K	NC	NC	5.2VAC	*	0	0	240	12K	0.8	470K	4	490				
V109	6AW8A	2.9	490	0.6	100K	245	12K	5.2VAC	*	0	0	2.7	1.2K	0	3.8	72	85K	250	11K
V110	6CB6	0	3.8	1.5	320	5.2VAC	*	0	0	240	13K	95	125K	0	0				
V111(LIN)	6AU6	0	100K	0	0	5.2VAC	*	0	0	230	16K	72	33K	1.05	200				
V111(LOG)	6AU6	-.5	240K	0	0	5.2VAC	*	0	0	230	16K	100	27K	1.1	200				
V111(PWR)	6AU6	0	100K	0	0	5.2VAC	*	0	0	250	16K	25	5K	.55	200				
V112	12AU7	142	30K	0	1M	4.3	750	5.2VAC	*	5.2VAC	*	-0.3	110K	-0.3	110K	0.4	123	0	0
V113	12AT7	36	270K	0.8	7K	1.8	2.2K	5.2VAC	*	5.2VAC	*	250	12K	-7	320K	0.9	4.7K	0	0
V114(LIN)	12AU7	70	110K	-0.3	310K	2.4	740	5.2VAC	*	5.2VAC	*	135	120K	8.3	140K	16	5.6K	0	0
V114(PWR)	12AU7	74	110K	-.88	5K	2.4	740	5.2VAC	*	5.2VAC	*	135	120K	8.3	140K	16	5.6K	0	0
V115	12AX7	250	11K	-47	1M	1	1K	5.2VAC	*	5.2VAC	*	175	110K	-1.5	470K	0	0	0	0
V116	OA2	150	13K	0	0	NC	NC	NC	NC	150	13K	NC	NC	NC	NC				
V117	12BY7	3	160	0	56K	3	160	6	8	-6.3	5	0.3	7	145	13K	150	13K	3	160
V118	6BK7	65	28K	-2.8	51K	0	0	0	6.8	6	8	62	28K	-2.4	51K	0	0	0	0
V119	6J6	135	16K	140	16K	-6.3	5	0	6.8	-5.7	390K	-5.7	390K	2	240				
V120	12AT7	85	1M	-4.8	1.1M	0.1	1K	5.2VAC	*	5.2VAC	*	92	240K	-46	1M	2.2	3K	0	0
V121	6U8	250	11K	-1.2	1.1M	0.1	1K	5.2 VAC	*	0	0	127	480K	0	0	130	24K	125	480K
V122	12AU7	135	200K	0.6	460K	9.3	3.3K	5.2VAC	*	5.2VAC	*	135	240K	12	160K	4	5.2K	0	0
V123	5ADP7	-1750	1.7M	-1720	1.6M	-1700	2M	NC	NC	-1170	1.1M	NC	NC	135	240K	135	200K	165	35K

10		11		12		13		14	
V	R	V	R	V	R	V	R	V	R
135	120K	70	110K	NC	NC	NC	NC	-1750	1.7M

POWER SUPPLY

CIRCUIT REF. SYMBOL	TYPE	PIN NUMBERS 1		2		3		4		5		6		7		8		9		CAP	
		V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R
V1	5U4	460	□	460	□	NC	NC	425AC	28	NC	NC	425AC	26	NC	NC	460	□				
V2	6146	NC	NC	⊗	∞	460	□	NC	NC	93	8.2M	250	7K	⊗	∞	NC	NC			460	□
V3	6146	NC	NC	⊗	∞	460	□	NC	NC	93	8.2M	250	7K	⊗	∞	NC	NC			460	□
V4	12AX7	250	7K	72	1.7M	80	240K	⊗	∞	⊗	∞	93	8.2M	55	1.7M	80	240K	⊗	∞		
V5	12AX7	150	825K	50	65K	50	240K	⊗	∞	⊗	120	825K	50	58K	50	240K	⊗	∞			
V6	5651	NC	NC	0	0	NC	NC	NC	NC	85	60K	NC	NC	NC	NC						
V7	5651	0	0	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	-85	45K						

LEGEND – *VERY LOW RESISTANCE.
NC-NO CONNECTION
□LEAKAGE, DO NOT MEASURE
⊗NOT MEASUREABLE TO GROUND
5.25 VAC MEASURED ACROSS PINS 4 & 9
∞NO DC PATH TO CHASSIS GROUND

NOTES:

ALL VOLTAGES ARE DC UNLESS OTHERWISE SPECIFIED.

TABLE V-1, STAGE GAIN CHART

CIRCUIT REF SYM	TYPE	PIN	FREQ	INPUT VOLTAGE
V101	6BQ7	2	2 mc	20 uv
V102	6CB6	1	2 mc	37 uv
V103	6J6	6	2 mc	240 uv
V104	5879	1	2 mc	510 uv
V105	5879	1	2 mc	590 uv
V104	5879	1	32 mc	260 uv
V105	5879	1	32 mc	240 uv
V106A	6AW8A	7	32 mc	80 uv
V107	6BE6	7	32 mc	455 uv
V107	6BE6	7	2.7 mc	1200 uv
V108	6AB4	6	2.7 mc	3.7 K uv
V109A	6AW8A	7	2.7 mc	1.1 K uv
V109B	6AW8A	2	2.7 mc	8 K uv
V110	6CB6	1	2.7 mc	2.5 K uv
V111	6AU6	1	2.7 mc	100 K uv
V112	12AU7	7	D. C.	-7 volts
V114	12AU7	2	D. C.	-6.7 volts
V114	12AU7	1	D. C.	+135V*
V114	12AU7	6	D. C.	+78V*
V114	12AU7	7	D. C.	+16V*

* D. C. voltages for -7 volts. Input at pin 7 of V112.

V-2. TOUCH-UP ALIGNMENT

CAUTION

> These adjustments should not be attempted unless suitable instruments and sufficiently skilled, experienced personnel are available.

This section indicates adjustments that may be needed when tubes or their associated components age or are changed. The chart indicates what to look for. It does not imply that any or all of the adjustments need be made. When a tube or associated component is changed, check the equipment operation before any adjustments are attempted in order to determine need for adjustment. Before any adjustments of chassis controls are made, the procedure should be read to determine the expected result. Wherever possible, the equipment should then be checked to see if it is already providing the desired result. Only if the equipment does not yield the desired result should the adjustment be made.

Equipment requirements are listed in the introductory paragraphs of V-4.

Before beginning any touch-up alignment, follow the interconnection and adjustment procedures outlined in II-3 and II-4 a, b, c, d. Allow at least a half hour warm-up period. After the warm-up period, connect a voltmeter (whose accuracy is known to be ±3% or better at 250 volts) to the +250 V TEST pin jack on the rear apron of the PS-19 and, if necessary, adjust the +250 V ADJUST chassis control of the PS-19 for a B+ reading on the voltmeter of +250 volts dc.

a. GUIDE TO ADJUSTMENT.

ANALYZER SECTION		
REFERENCE SYMBOL	TUBE TYPE	REQUIRED PROCEDURE
V101	6BQ7A	Reset IF GAIN
V102	6CB6	Reset IF GAIN
V103	6J6	Reset IF GAIN
V104	5879	Reset C131,
V105	5879	IF GAIN
V106	6AW8A	Reset IF GAIN
V107	6BE6	Reset IF GAIN
V108	6AB4	Reset IF GAIN, L111
V109	6AW8A	Reset IF GAIN, L117
V110	6CB6	Reset IF GAIN
V111	6AU6	Reset 20 DB LOG ADJ and 0 DB LOG ADJ Reset IF GAIN
V112	12AU7	Check LIN and LOG screen calibrations
V113	12AT7	Check PWR (power) AMPLITUDE SCALE, See III-4b(7).
V114	12AU7	Reset Vertical POSition and check crt screen amplitude calibrations

REFERENCE SYMBOL	TUBE TYPE	REQUIRED PROCEDURE
V115	12AX7	None
V116	OA2	None
V117	12BY7	If the voltage at J115 is not 0.95 volts, reset BIAS. Reset SWEEP LIMIT and/or R342 (SPA-3/25)
V118	6BK7	Check SWEEP WIDTH and CENTER FREQUENCY dial calibrations Reset OSC TRIMMER (C263) and L129 if required
V119	6J6	Reset IF GAIN
V120	12AT7	None
V121	6U8	Reset LINE SIZE, CF BAL
V122	5ADP7	Reset BRILLIANCE, FOCUS, Vertical POSition, Horizontal POSition and IF GAIN Check crt screen amplitude calibrations

POWER SUPPLY SECTION		
REFERENCE SYMBOL	TUBE TYPE	REQUIRED PROCEDURE
V1	5U4	
V2	6146	
V3	6146	
V4	12AX7	Check for +250v at J5 Reset +250v ADJ. It is important to use a voltmeter which is known to be accurate to ±3%.
V5	12AX7	
V6	5651	

b. ADJUSTMENT PROCEDURES.*

(1) IF GAIN.

If the equipment sensitivity is incorrect adjust the IF GAIN control using the following procedure.

Set the CENTER FREQUENCY dial to 2 MC and the SWEEP WIDTH dial to 3 mc. Set the other front-panel controls as listed in paragraph II-4k. Connect a 2 mc, 20 uv signal to the analyzer INPUT. Set IF GAIN for a full scale pip on the crt screen.

(2) C131.

If good suppression of the zero-frequency pip cannot be obtained, reset C131 in accordance with the following procedure.

Set the CENTER FREQUENCY dial to 0 and the other front panel controls as listed in paragraph II-4a.

Set A BALance and S BALance to the center of their rotational range. Adjust C131 for best suppression of the zero-frequency pip. Adjust A BALance and S BALance for best suppression of the zero-frequency pip. Trim C131, A BALance and S BALance for best suppression of the zero-frequency pip.

Set IF ATTENuator to 0 DB and trim C131, A BALance and S BALance for best suppression of the zero-frequency pip.

(3) L111, L117.

If resolution range is unsatisfactory (if bandwidth cannot be made broad enough), adjust L111 and/or L117 in accordance with the following procedure.

Connect a 2 mc signal to the analyzer-section INPUT. Set SWEEP WIDTH to 3 mc and CENTER FREQUENCY for a centered 2 mc pip. Adjust SWEEP WIDTH, while maintaining the pip at the center of the screen with the CENTER FREQUENCY control, so that the base of the pip occupies approximately 1/3 of the baseline.

Remove crystal Y102. Trim L117 for minimum deflection and broadest pip, adjusting the INPUT ATTENUATOR and SWEEP WIDTH controls to keep the sides of the pip visible. If the pip moves across the screen, keep it centered by use of the CENTER FREQUENCY control or by shifting the input frequency. Note that when the coil is correctly set, a condition of minimum height and broadest pip will be achieved. As the coil is tuned away from the correct position, the pip will increase in amplitude, become narrower, and shift horizontally. After L117 is correctly set, replace crystal Y102.

Remove crystal Y103 and repeat the above procedure using L111 in place of L117. When L111 is correctly set, replace crystal Y103.

---

* The functions of the service controls and factory-adjusted components are given in Section V-3.

(4) 20 DB LOG ADJ, 0 DB LOG ADJ

If the logarithmic amplitude scale calibrations are incorrect, adjust 20 DB LOG ADJ and 0 DB LOG ADJ in accordance with the procedures of paragraph V-4f.

(5) SWEEP LIMIT and R342 (SPA-3/25).

With the SPA-3, if the sweep width is not 3 mc when the SWEEP WIDTH dial is set for 3 MC, reset the SWEEP LIMIT control. With the SPA-3/25, if the sweep width is not 3 mc when the SWEEP WIDTH dial is set for 3 MC, reset the SWEEP LIMIT control on the LO band and R342 on the HI band. Use the marker pips to determine the sweep width as indicated in paragraph II-4g.

(6) OSC TRIMMER (C263), L129.

If the CENTER FREQUENCY dial calibrations are incorrect (be sure that the Center Frequency VERNier is correctly set per paragraph III-3c before finding fault with the dial), adjust OSC TRIMMER (C263) and L129 in accordance with the procedures of subparagraphs V-4d(3), (5) and (6). Before starting, be sure that the BIAS control is set for 0.95 volts at the BIAS TEST jack on top of the oscillator chassis and that the Center Frequency VERNier is in the center of its rotational range.

(7) LINE SIZE, CF BAL.

If the size of the baseline is not correct and/or if it is not centered after Horizontal POSition is adjusted per paragraph II-4g, adjust LINE SIZE and if necessary CF BAL in accordance with the procedures of paragraph V-4a(3).

(8) R341 (SPA-3).

If the sweep width changes more than ±15% as the CENTER FREQUENCY control is changed from 0 to 13.5 MC, redetermine the value of R341 (after first determining that the gearing associated with the CENTER FREQUENCY control has not loosened). With the SWEEP WIDTH dial set for a 3 MC sweep width, check the sweep width at a 1.5 MC and 13.5 MC center frequency and at several intermediate points using the frequency markers. Choose a value for R341 that results in least change in sweep width over the range of the CENTER FREQUENCY control.

(9) R343, R344 (SPA-3/25).

R343 and R344 serve the same function and are set for the same reasons, using the same procedures as are indicated for R341 in subparagraph (8) above. First select R344 for the LO band and then R343 for the HI band.

V-3. SERVICE, CONTROLS AND FACTORY SELECTED COMPONENTS

The controls and components described in this section are for adjustment only in maintenance and service of the equipment. They should not be adjusted by operating personnel but should be left to experienced service personnel and should only be adjusted in accordance with the procedures given in sections V-2 and V-4.

a. IF ATTEN ADJUST, R181.

This control is used to set the IF ATTENuator switch circuitry to provide 20 db of attenuation.

b. IF GAIN, R187.

This control is used to adjust the gain of V106A for correct equipment standard sensitivity.

c. 20 DB LOG ADJ, R261 and 0 DB LOG ADJ, R279.

These controls are used to adjust the last i-f stage and the detector circuit to provide proper LOG amplitude screen calibration.

d. BIAS, R353

This control is used to set the current flow through the Vari-L inductor (L127) such that the center frequency-versus-temperature drift of the sweeping oscillator is at a minimum.

e. CF BAL, R411.

This control is used to obtain a zero average dc level of the sawtooth voltage, thereby permitting correct baseline centering.

f. LINE SIZE, R415.

This control is used to obtain correct crt baseline size.

g. EXT. LINE SIZE, R417.

This control is used to obtain correct crt baseline size when an external sweep source is used.

h. SWEEP LIMIT, R421; R342 (SPA-3/25).

On the SPA-3, the SWEEP LIMIT control is used to set the maximum sweep width of the equipment. On the SPA-3/25, the control is used to set the maximum sweep width for the LO Band

and R342 is used to set the maximum sweep width for the HI Band.

i. R137, R142

R137 is part of the frequency compensation network of the input cascode amplifier V101A. R142 is part of the frequency-compensation network of the Wide Band Input Amplifier.

j. R228, R245.

These resistors are selected for an optimum shape of the amplitude-versus-frequency response curve of the 2.7 mc i-f amplifier section.

k. R263.

This resistor is used to provide adequate range for the 20 DB LOG ADJ control.

l. R341 (SPA-3); R343 and R344 (SPA-3/25).

These resistors are selected to minimize variation in sweep width as the center frequency is changed.

m. C107, C115, C117.

These variable capacitors are part of frequency compensation networks of the input stage of the equipment. C107 is part of the input wide band amplifier (V102). C115 and C117 are part of the paraphase amplifier (V103).

n. C131

This variable capacitor is used to provide correct phase balance between the outputs of the two sections of the balanced modulator (V104, V105).

o. C167.

This variable capacitor is the neutralizing capacitor for crystal Y102.

p. C179.

This variable capacitor is part of the tuned-plate circuit of the first 2.7 mc tuned i-f amplifier (V109A).

q. C185.

This variable capacitor is the neutralizing capacitor for crystal Y103.

r. C263, OSC TRIMMER, C270 (SPA-3/25).

Variable capacitor C263 is used in conjunction with L129 to set the range of the CENTER FREQUENCY control. This capacitor is used to set the 13.5 mc end of the dial on the SPA-3 and to set the high frequency end of the dial on the LO BAND on the SPA-3/25. C270 is used to set the 23.5 mc end (HI BAND) of the SPA-3/25 dial.

s. L109.

This variable inductance is part of the tuned circuit associated with the 29.3 mc crystal oscillator (V106B).

t. L111.

This variable inductance is the load coil for crystal filter Y102.

u. L117.

This variable inductance is the load coil for crystal filter Y103.

v. L129.

This variable inductance is used in conjunction with the OSC TRIMMER (C263) to set the range of the CENTER FREQUENCY control. The inductor is used to set the zero-frequency end of the dial.

V-4. COMPLETE FIELD ALIGNMENT PROCEDURE

This is a complete field alignment procedure. It is only under the most unusual circumstances that this procedure will have to be used in its entirety. Most of the alignment problems encountered in the field can be solved by using the applicable adjustment techniques given in Section V-2. The complete alignment should not be attempted unless suitable instruments and sufficiently skilled, experienced personnel are available.

Before making any adjustment, the procedure should be read to determine the expected result. Wherever possible, the equipment should then be checked to see if it is already providing the desired result. Only if the equipment does not yield the desired result should the adjustment be made.

The following equipment is required:

1. Well calibrated, low-harmonic content signal generators (with accurate internal or external level indicators), to cover the frequency range of 200 cps to 15 mc (to 25 mc in the case of SPA-3/25).
2. A voltmeter accurate to ±3% at 250 v dc.

Before beginning the alignment, follow the interconnecting procedure given in II-3. Allow at least a half hour warm-up period. After the warm-up period, connect a voltmeter (whose accuracy is known to be ±3% or better at 250 volts) to the +250 V TEST pin jack on the rear apron of the PS-19 and, if necessary, adjust the +250 V ADJUST chassis control of the PS-19 for a B+ reading on the voltmeter of +250 volts dc.

a. BASELINE ADJUSTMENT.

(1) Adjust FOCUS, BRILLIANCE (located on front panel), and ASTIG (located on analyzer chassis) as required for a suitable trace. FOCUS and ASTIGMATISM should be set for a clear, sharp, uniform trace. BRILLIANCE should be set at the minimum point of suitable visibility. Do not use the BRILLIANCE control to compete with external light falling on the crt screen but rather shield the screen from the external light. If the baseline trace does not coincide with the baseline of the calibrated screen, a suitable adjustment of the Vertical POSition control should be made. If there is a lack of parallelism, rotate the crt in accordance with the procedures given in II-4c.

(2) Adjust the SWEEP RATE control so that the sweep rate of the crt beam is 30 cps and set the CAL-SYNC SELector to the LINE position. (See paragraph II-4e).

(3) Adjust the LINE SIZE, CF BAL, and Horizontal POSition controls in accordance with the following procedure.

(a) Set Horizontal POSition to the center of its rotational range.

(b) Set LINE SIZE such that the baseline length is approximately that of the calibrated portion of the crt screen. If the line is not centered, use the CF BAL control to obtain a centered line.

(c) Set CENTER FREQUENCY to 10 MC, SWEEP WIDTH to 3 mc, IF ATTENUATOR to 0 DB, and AMPLITUDE SCALE to LINEAR. Switch on the internal marker by rotating the MARKER AMPLITUDE control clockwise. Adjust the control for a convenient height of marker presentation. The 10-mc marker pip should be at or near the center of the screen. Gradually reduce SWEEP WIDTH to minimum, maintaining the 10-mc pip at the center of the screen with the CENTER FREQUENCY control. Return to 3-mc sweep width and adjust Horizontal POSition until the top of the pip coincides with the center vertical line on the screen.

(d) Trim LINE SIZE and CF BAL until a centered line of the correct length is obtained. The length of the baseline is correct if it extends at least 1/8 inch beyond the calibrated portion of the crt screen at all sweep rates and does not extend past the edges of the crt screen at least at one sweep rate.

b. IF ALIGNMENT.

NOTE

1. It may be necessary to adjust the input signal levels to keep the baseline trace on the screen.
2. All coils are tunable from the top of the chassis. Bottom core adjustments are made by passing the black end of the supplied Walsco #2543 alignment tool through the hollow top core until the end of the tool engages the bottom core. Care must be taken, when removing the tool, not to disturb the setting of the top core. For this reason, wherever possible, it is better to adjust the bottom core before the top core is adjusted. The top core can be adjusted with either the black or blue end of the tool.

(1) Set AMPLITUDE SCALE to LINear. Set IF ATTENuator to 0 DB. Set CENTER FREQUENCY to 2 MC. Set SWEEP WIDTH to 0. Set IF BANDWIDTH to MAXimum. Set VIDEO FILTER to OFF. Set SWEEP RATE to 30 cps. Set IF GAIN to 3/4 maximum clockwise rotation.

(2) Couple a 2.7-mc signal through a 0.01-uf capacitor to pin 1 of V111. Adjust the top and bottom cores of T106 for a maximum baseline rise. The 0.01-uf capacitor should also be used in the following steps.

(3) Connect the 2.7-mc signal to pin 1 of V110. Adjust the top and bottom cores of T105 for a maximum baseline rise.

(4) Connect the 2.7-mc signal to pin 7 of V107. Adjust the top and bottom cores of T104 for a maximum baseline rise. Adjust C179 for a maximum baseline rise.

(5) Couple a 32.0-mc signal through a 0.01-uf capacitor to pin 7 of V106. Adjust the top and bottom cores of T103 for a maximum baseline rise.

(6) Connect the 32.0-mc signal to pin 1 of V104. Adjust the bottom cores of T102 and T101 for maximum baseline rise.

c. ADJUSTMENT OF CRYSTAL-FILTER CIRCUITS.

NOTE

If it is necessary to replace crystals, the replacement crystals should be obtained in matched pairs from Panoramic Electronics Inc.

(1) Set the SWEEP WIDTH control to 3 mc.

(2) Connect a 2-mc signal to the analyzer INPUT connector.

(3) Set the CENTER FREQUENCY control so that the 2-mc pip is in the center of the screen. Trim the top and bottom cores of T106, T105, T104 and T103 for maximum pip deflection. Trim C179 and the bottom cores of T102 and T101 for maximum pip deflection.

(4) Tune L109 for maximum pip deflection.

(5) Adjust the SWEEP WIDTH control, while maintaining the pip at the center of the screen with the CENTER FREQUENCY control, so that the base of the pip occupies approximately 1/3 of the baseline.

(6) Remove crystal Y102. Adjust the INPUT ATTENUATOR, STEP to any convenient position other than 0 DB. Set the signal generator output level for a full-scale pip. Trim C185 to remove the rejection slot as follows. Rotate C185 through 360 degrees noting the change in pip shape. At some point of rotation, the pip should approximate the shape shown in Figure V-2a or its mirror image.

As rotation is continued, the rejection slot should sharpen and disappear into the side of the pip. Continued rotation should cause the rejection slot to appear on the other side of the pip. Reverse the rotation and choose a point at which pip symmetry is best and no rejection slot is present. This is illustrated in Figure V-2b. This point should be approximately halfway between the two positions at which the rejection enters the pip from the sides. Reset the INPUT ATTENUATOR, STEP for 20 db less attenuation thereby causing the pip to go over full scale. If necessary, adjust SWEEP WIDTH so that the sides of the pip go into the baseline. Trim C185 for absence of rejection slot and best pip symmetry.

(7) Adjust the INPUT ATTENUATOR as necessary to give a full-scale pip.

(8) Adjust L117 for minimum deflection and broadest pip, adjusting the INPUT ATTENUATOR and SWEEP WIDTH controls to keep the sides of the pip visible. If the pip moves across the screen, keep it centered by use of the CENTER FREQUENCY control or by shifting the input frequency. Note that when the coil is correctly adjusted, a condition of minimum height and broadest pip will be achieved. As the coil is tuned away from the correct position, the pip will increase in amplitude, become narrower, and shift horizontally.

(9) Repeat steps 6, 7 and 8.

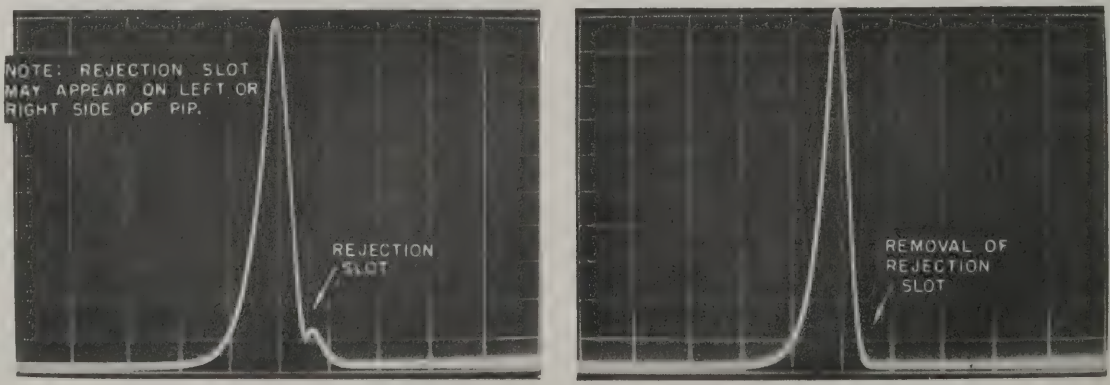
(10) Replace crystal Y102.

(11) Remove crystal Y103.

(12) If necessary, readjust the INPUT ATTENUATOR for a full-scale pip.

(13) Repeat steps 6 through 9 using C167 and L111 in place of C185 and L117.

(14) Replace crystal Y103.


NOTE: REJECTION SLOT MAY APPEAR ON LEFT OR RIGHT SIDE OF PIP.
REJECTION SLOT
REMOVAL OF REJECTION SLOT

a. Illustration of Rejection Slot.

b. Illustration of Complete Rejection Slot Removal.

Figure V-2. Crystal Rejection Slot Removal.

(15) Adjust controls for a full-scale broad pip as in step 5.

(16) Adjust the IF BANDWIDTH control counterclockwise until optimum resolution is obtained. See subparagraph III-4d(5) and Figure III-7.

(17) Touch-up the following transformers, coils, and capacitor for maximum pip height: T106, T105, C179, T104, T103, T102, T101 and L109.

d. OSCILLATOR ALIGNMENT.

(1) Adjust the BIAS control R353 located on the oscillator chassis for 0.95 volts d-c as measured at the BIAS TEST jack on top of the oscillator chassis.

(2) If the gear coupling between the center frequency capacitor and sweep width track potentiometer has been disturbed*, proceed as follows: With the power off, remove fiducial, knobs, and CENTER FREQUENCY dial plate. Disconnect all cables from oscillator. Remove oscillator chassis. Tighten set screws on capacitor drive gear. Loosen set screws on sweep width track pot gear. Turn sweep width track pot to the maximum counterclockwise position. Turn the CENTER FREQUENCY capacitor counterclockwise until the plates are fully meshed. Then turn the capacitor about 5 degrees further. Tighten set screws on sweep width track pot gear. Turn power on, set SWEEP WIDTH to 3 mc.** Turn CENTER FREQUENCY control counterclockwise and note how far the zero-frequency pip moves to the right before it reverses direction. The travel to the right should be for one horizontal screen division. If it is not, turn power off and reset center frequency capacitor. If the travel is greater than one division, turn the capacitor slightly clockwise. If it is less, turn the capacitor slightly counterclockwise. Install oscillator chassis, CENTER FREQUENCY dial plate, fiducial and knobs. Attach all cables. Repeat Step 1.

(3) Turn CENTER FREQUENCY dial to 0. (If the equipment is an SPA-3/25, be sure that it is set for the LO BAND). Set the SWEEP WIDTH dial to 0.5 mc. Adjust L129 (on top of oscillator sub-chassis) so that zero frequency pip is in the center of the screen.

(4) (SPA-3) Connect a 13.5 mc signal to the analyzer input. Turn CENTER FREQUENCY dial to 13.5 MC. Adjust C263, located on top of oscillator sub-chassis, so that the 13.5 mc pip is in the center of the screen.

(SPA-3/25) Set equipment for the LO BAND. Connect a 10.5 mc signal to the analyzer input. Turn CENTER FREQUENCY dial to 10.5 MC. Adjust C263, located on top of oscillator sub-chassis, so that the 10.5 mc pip is in center of the screen.

(5) Repeat steps 3 and 4 until "0" and "13.5" on SPA-3 and "0" and "10.5" on SPA-3/25 are calibrated correctly.

(6) (SPA-3/25 only) Connect a 23.5 mc signal to the SPA-3/25 input. Set the CENTER FREQUENCY dial to 23.5 MC. (Be sure the equipment is set for the HI BAND). If necessary, change the value of C270 such that the 23.5 mc pip is in the center of the screen.

(7) The CENTER FREQUENCY dial calibrations can be checked by using the internal markers. See paragraph II-4j. Turn on the markers by rotating the MARKER AMPLITUDE control clockwise. If required, construct an error chart for the dial or calibrate a new dial.

(8) With the SWEEP WIDTH dial set to 3 MC, center a 2 mc pip on the screen. Using the markers as an indication, set the SWEEP WIDTH LIMIT control so that the sweep is 3 mc. The sweep is 3 mc when the third marker pip to the left and to the right of the 2 mc pip are within ±1/2 division from the left and right edge of the calibrated crt screen rectangle. If the equipment is an SPA-3/25, after the SWEEP WIDTH LIMIT control is set on the center frequency LO BAND, set R342 for 3 mc sweep width at a 10.5 mc center frequency, (HI BAND).

(9) Check the SWEEP WIDTH dial calibrations per paragraph II-4i. If required, construct an error chart for the dial or calibrate a new dial.

e. FLATNESS ADJUSTMENTS.

Be sure that the signals used are connected correctly to the spectrum analyzer. See paragraph II-3d.

(1) Connect a 20 uv, 2 mc signal to the analyzer input. Set all attenuators to minimum attenuation. Set CENTER FREQUENCY to 2 MC. Set SWEEP WIDTH to 3 MC. Set AMPLITUDE SCALE switch to LINear. Adjust IF GAIN so that the 20 uv, 2 mc pip is of full scale amplitude.

(2) Connect a 20 uf, 13.5 mc signal (23.5 mc for SPA-3/25) to the input connector. Tune C107,

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* This will happen only if the gearing associated with the CENTER FREQUENCY control loosens.

** Attach all cables to oscillator.

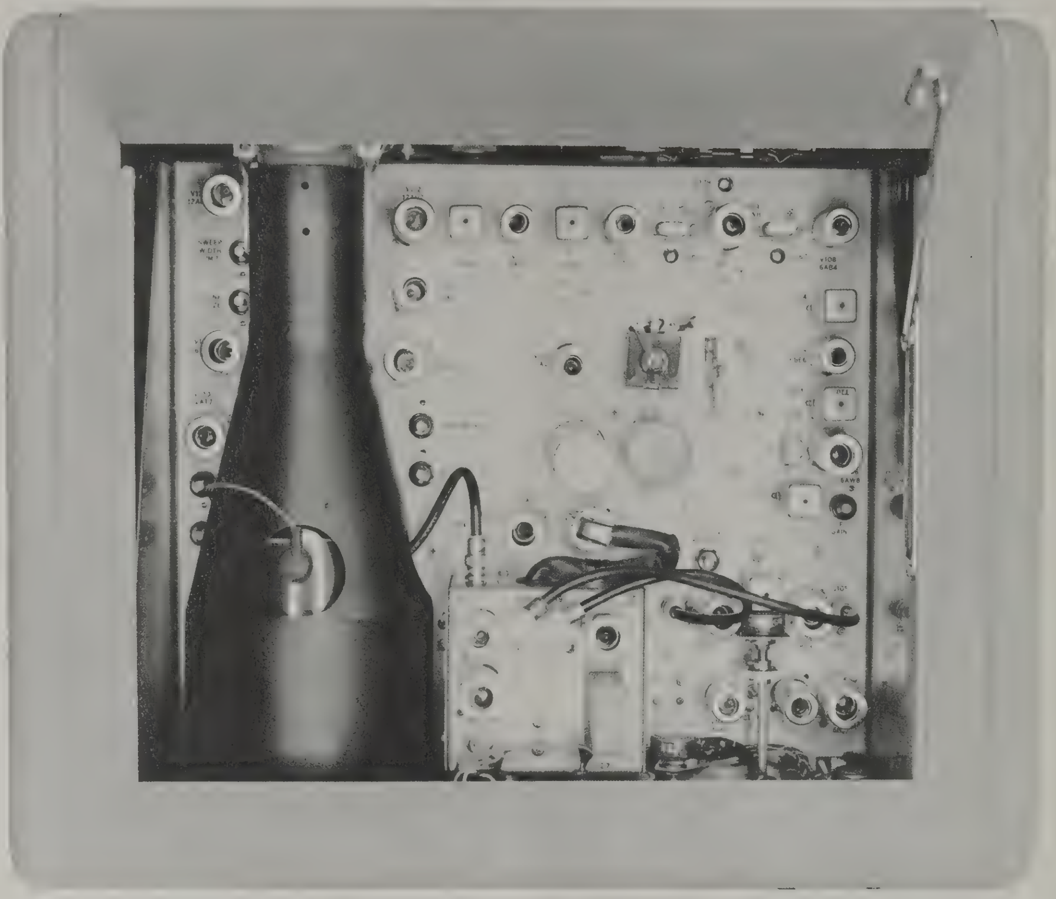

Figure V-3. Top Internal View Model SPA-3/25 Mounted in Style B Cabinet.

C115 and C117 for maximum pip height and then for best flatness.

(3) Check amplitude flatness over the frequency range of the equipment. If the high frequency end drops off excessively, slightly reduce the values of factory select resistor R137 and R142. Repeat steps (1) and (2). If the high frequency end rises excessively, slightly increase the value of the factory select resistors R137 and R142. Repeat steps (1) and (2).

f. ADJUSTING THE LIN-LOG AMPLITUDE SCALES AND STANDARD SENSITIVITY.

(1) Set the CENTER FREQUENCY dial to 2 MC, the SWEEP WIDTH dial to 0.5 MC, the IF ATTEN to 0 DB, and the AMPLITUDE SCALE to LINear. Connect a 2 mc signal to the analyzer section input and adjust its level for a full scale crt deflection.

(2) Set AMPLITUDE SCALE to LOGarithmic.

(3) Adjust 20 DB LOG ADJ for a 20 db pip height on the DB amplitude scale of the crt screen.

(4) Increase the input signal amplitude 10 times.

(5) Adjust 0 DB LOG ADJ for a full-scale pip.

(6) Repeat steps 1 through 5 until the LOGarithmic amplitude scale is correct.

(7) Set AMPLITUDE SCALE to LINear. All attenuation to minimum attenuation. Adjust IF GAIN so that a 20 uv, 2 mc pip is of full-scale amplitude.

(8) Check the calibration points on the crt amplitude scales and if necessary construct an error chart or calibrate a new crt screen.

g. ADJUSTING THE IF ATTENuator.

(1) Set the IF ATTENuator to 0 DB, the CENTER FREQUENCY dial to 2 MC, the SWEEP WIDTH dial to 0.5 mc, and the AMPLITUDE SCALE to LINear. Connect a 2 mc signal to the analyzer input and adjust its level for a full-scale crt deflection.

(2) Set the IF ATTENuator switch to 20 DB.

(3) Increase the input signal amplitude 10 times.

(4) Adjust IF ATTEN ADJUST for a full-scale pip.

V-5. FINAL TEST PROCEDURE

The Model SPA-3 should be tested after it has been repaired. Repaired equipment, meeting the standards indicated in the test procedures of this section, will furnish uniformly satisfactory operation.

a. MOUNTING, INTERCONNECTION, AND INITIAL ADJUSTMENTS.

Mount and interconnect the equipment in accordance with sections II-2 and II-3. Perform the initial adjustments given in section II-4, paragraphs a, b, c, and d.

b. SWEEP RATE.

Turn the SYNC AMPlitude control completely counterclockwise. Set the CAL-SYNC SELector to the CAL position. Set the SWEEP RATE control completely clockwise. Turn SYNC AMPlitude clockwise and if necessary trim the SWEEP RATE control until one cycle of sine wave appears stationary on the crt screen. This demonstrates that the maximum sweep rate is at least 60 cps. Turn SWEEP RATE completely counterclockwise. Using a watch, count the number of sweeps that occur in 20 seconds. There should be 20 or fewer sweeps in 20 seconds demonstrating that the minimum sweep rate is one cps or less.

This test demonstrates that the range of the SWEEP RATE control is at least 1 to 60 cps.

c. SENSITIVITY.

Adjust the sweep rate to approximately 30 cps in accordance with paragraph II-4e.

Set the front-panel controls as follows:

AMPLITUDE SCALE	LINear
IF ATTENuator	0 DB
INPUT ATTENUATOR, CONTINUOUS	Completely counterclockwise
INPUT ATTENUATOR, STEP	0 DB
IF BANDWIDTH	MAXimum
VIDEO FILTER	OFF
SWEEP WIDTH	3 MC

Connect a signal generator to the analyzer-section INPUT. Set the CENTER FREQUENCY dial and the signal generator to 2 mc. Set the generator level for a full-scale pip on the crt screen.

An approximately 20 microvolt input to the equipment indicates correct sensitivity.

Note that in the absence of a suitable signal generator, a rough check of sensitivity correctness is the presence of noise ("grass") on the screen when INPUT ATTENUATOR, STEP is set to 80 DB and IF ATTENuator is set to 0 db.

d. IF ATTENUATOR.

With the sweep rate set to 30 cps and the front panel controls set as in paragraph V-5c set the signal generator input for full-scale deflection on the crt and note the input amplitude. Set the IF ATTENuator to 20 DB. Reset the signal generator input level for full scale deflection. Note the required level.

If the IF ATTENuator control is working correctly, the generator input at 20 DB should be 9.8 to 10.2 times that at 0 DB.

e. INPUT ATTENUATOR, STEP and CONTINUOUS.

With the sweep rate set to 30 cps and the front-panel controls set as in paragraph V-5c, set the signal generator input for full-scale deflection on the crt and note the input amplitude. Set the INPUT ATTENUATOR to 20 DB, 40 DB, 60 DB and 80 DB, resetting and noting the generator level for a full-scale deflection on the crt at each position.

If the INPUT ATTENUATOR, STEP control is working correctly the level required at each position should be greater than that required at 0 DB by 20 DB ±1 db, 40 DB ±2 db, 60 DB ±3 db, 80 DB ±4 db, respectively.

Set the generator for full-scale deflection on the crt. Increase the generator input 10 times. Turn INPUT ATTENUATOR, CONTINUOUS completely clockwise.

If the INPUT ATTENUATOR, CONTINUOUS control is working correctly, the crt deflection should be full scale or less.

f. BALANCE.

Set the CENTER FREQUENCY dial to 0 and the other front-panel controls as in paragraph V-5c. At several sweep rates between 1 cps and 60 cps and several sweep widths between 0 and 3 mc it should be possible to cause the zero-frequency pip to go through a minimum point with the A BALance and S BALance controls.

g. MARKERS AND CENTER FREQUENCY DIAL.

Set the INPUT ATTENUATOR, STEP to 80 DB and the other front-panel controls as in paragraph V-5c. Note that at higher frequencies, the IF ATTENuator must be set to 0 DB to obtain a suitable marker presentation. Set the CENTER FREQUENCY dial to 10 MC. Switch the internal markers on by rotating the MARKER AMPLITUDE control clockwise. Adjust the control for a convenient height of marker presentation. The 10-mc marker pip should be at or near the center of the screen. Gradually reduce SWEEP WIDTH noting the change in the 10-mc pip. If the top of the pip moves to either side of its original position as sweep width is reduced, adjust the CENTER FREQUENCY dial slightly to keep the pip at the center of the screen. Return to 3-mc sweep width and adjust Horizontal POSition until the top of the pip with the center vertical line (0 frequency calibration) on the screen. Marker pips should be present every 0.5 mc from 0.5 mc to 15 mc on the SPA-3 and to 25 mc on the SPA-3/25.

Check the CENTER FREQUENCY dial by setting the SWEEP WIDTH dial to 3 mc and then matching the CENTER FREQUENCY dial calibrations with the corresponding marker frequency starting with the CENTER FREQUENCY dial set to 0. The top of the pip should appear at or near the center of the screen. Be sure that the Center Frequency VERNier is set such that the zero-frequency pip is at the center of the screen when the CENTER FREQUENCY dial is set to 0 MC.

h. SWEEP WIDTH DIAL.

Set the INPUT ATTENUATOR, STEP to 80 DB and the other front-panel controls as in paragraph V-5c. Using the marker pips, check the SWEEP WIDTH dial calibrations corresponding to frequencies above 0.5 mc. Set the SWEEP WIDTH to 3 mc and CENTER FREQUENCY to 1.5 mc. Turn MARKER AMPLITUDE on and set it for a convenient amplitude of marker display. The zero-frequency pip should be at or near the -0.5 calibration mark of the SWEEP WIDTH FACTOR screen scale. (It may be necessary to adjust A BALance and/or S BALance to unbalance the equipment sufficiently to see the zero-frequency pip.) The sixth marker pip to the right of the zero-frequency pip should be at or near the +0.5 mark of the SWEEP WIDTH FACTOR scale. (Each pip being 0.5-mc apart, the sixth pip to the right of the zero-frequency pip corresponds to a frequency of 3 mc. Since SWEEP WIDTH is set for 3 mc, a 3-mc pip should fall at +0.5 (±1/2 division) when the zero-frequency pip falls at -0.5 (±1/2 division) on the SWEEP WIDTH FACTOR scale. Note that it may be necessary to adjust CENTER FREQUENCY to center this display of six marker pips plus the zero-frequency pip. Other SWEEP WIDTH dial calibrations in increments of 0.5 mc between 0.5 mc and 3 mc can be checked using the 0.5-mc-apart marker pips. For example, setting the CENTER FREQUENCY dial for 1.75 MC and the SWEEP WIDTH dial for 0.5 mc, marker pips should appear at 0.5 and -0.5 on the SWEEP WIDTH FACTOR scale (approximately).

To check sweep widths narrower than 0.5 mc, an amplitude-modulated signal may be used. The modulating source should be set to a frequency equal to one-half the SWEEP WIDTH dial setting. The CENTER FREQUENCY dial should be set to the carrier frequency. The upper and lower sidebands may then be used to determine the actual sweep width. Note that in order to have suitable pips at narrow sweep widths it may be necessary to reduce the sweep rate and the i-f bandwidth thereby improving resolution. Section III4d contains a more extended discussion of narrow-band techniques.

i. FREQUENCY LINEARITY.

With the SWEEP WIDTH dial set accurately for a 3-mc sweep width (use the markers) and the other front-panel controls set as in paragraph V-5c., center a convenient input pip on the screen. Change the input frequency in five steps of 300 kc above and below the frequency of the center pip. Each signal pip should fall within ±1/2 a screen division of its appropriate screen marking if the frequency linearity is correct. Note that this test can be performed conveniently by using a harmonically rich 300-kc signal source to place 11 pips on the crt screen which are equally spaced in frequency.

j. RESOLUTION.

Representative points on the resolution graph (Figure I-2) may be checked by using the following procedure.

(1) Set the front-panel controls as indicated in paragraph V-5c.

(2) Connect an fm signal generator to the analyzer input and set the CENTER FREQUENCY dial appropriate to the generator output.

(3) Adjust the IF BANDWIDTH control for optimum resolution. (See III-4d(5) and Figure III-7.

(4) Frequency modulate the signal generator carrier with a frequency-calibrated oscillator. (A range of approximately 200 cps to 20 kc is required to check the full range of resolution.)

(5) Adjust the f-m signal generator and the modulating oscillator such that the carrier and the closest modulation product are both full-scale pips whose point of intersection is 50 per cent down from the top of the pips. The frequency setting of the modulating oscillator is the resolution of the analyzer.

k. AMPLITUDE RESPONSE.

Set the front-panel controls as in paragraph V-5c. Set the SWEEP WIDTH dial to 3 mc and CENTER FREQUENCY dial to 0.5 MC. Set the generator frequency to 0.5 mc and adjust its level for a full-scale deflection on the crt. Be sure that the generator is connected in accordance with paragraph II-3d since mis-matching will effect amplitude response. If the Model PRB-1a is used, see V-5a. Maintaining a constant-amplitude input to the equipment, vary the frequency of the generator from 0.5 mc to 13.5 mc (to 23.5 mc with an SPA-3/25), maintaining the pip at the center of the crt screen with the CENTER FREQUENCY dial. The variation of pip amplitude should not be greater than ±15%.

It usually is not necessary to check the amplitude response at the low-frequency end of the range since it is unusual for failure to occur at this end of the range. If failure is suspected, measurements have to be made at reduced sweep width, reduced sweep rate, and narrow i-f bandwidth. (See Paragraph III-4d for narrow-band techniques.) Since adjustment of sweep width, sweep rate, and i-f bandwidth changes sensitivity, in order to measure amplitude-versus-frequency response down to 1 kc, it is necessary to correlate sensitivities at various sweep widths, sweep rates, and i-f bandwidths.

l. CRT Amplitude Scale.

Check the amplitude scales using a signal of variable and known amplitude and low distortion. The voltages given in these checks are approximate since the instrument measures relative amplitude rather than absolute amplitude. Any convenient fixed CENTER FREQUENCY and SWEEP WIDTH dial settings compatible with the generator frequency and pip readability may be used. Set the controls as follows:

AMPLITUDE SCALE	LINear
IF ATTENuator.........	20 DB
INPUT ATTENUATOR, CONTINUOUS	Completely counterclockwise
INPUT ATTENUATOR, STEP..............	0 DB
IF BANDWIDTH	MAXimum
VIDEO FILTER.........	OFF
SWEEP RATE..........	30 cps

Adjust the generator level for a full-scale crt deflection. Switch AMPLITUDE SCALE to LOGarithmic. The pip amplitude should be in line with the 20 DB calibration dot on the left side of the calibrated crt scale. Change IF ATTENuator, STEP to 0 DB. Pip amplitude will again increase to full scale. Intermediate amplitude calibration points on the crt screen for both the LINear and LOGarithmic positions of AMPLITUDE SCALE may be checked against known input levels.

Switch AMPLITUDE SCALE to PWR (power). Using INPUT ATTENUATOR, STEP and CONTINUOUS, obtain a full-scale pip. Decrease the input amplitude of the signal 3 DB. The pip amplitude should decrease approximately 5 linear divisions of the crt screen. Note that because of a-c coupling in the circuit, the PWR (power) scale functions properly only with narrow pips and high sweep rates.

m. OPERATION WITH MODEL SW-1.

If the Model SPA-3 or SPA-3/25 is supplied with a Model SW-1, interconnect the two units in accordance with paragraph VI-2e. Turn on the power switch of the SW-1. The SW-1 relay should switch at the end of each analyzer sweep.

n. PROBE OPERATION.

If the Model SPA-3 or SPA-3/25 is supplied with a Model PRB-1a probe, perform the following checks.

Set the front-panel control as in paragraph V-5c.

Set the CENTER FREQUENCY dial to 2 MC and the signal generator frequency to 2 mc.

Connect the probe, without any attenuator head, to the analyzer in accordance with paragraph VI-1c. Connect the signal generator to the input of the probe through the normal output termination of the generator. Set the generator level for a full-scale deflection on the crt and note the generator level. Using the 20-db attenuator head, adjust the generator output for full-scale deflection on the crt. If the probe is working correctly, the generator output should be approximately 10 times that required for direct input to the analyzer. Using the 40-db attenuator head, adjust the generator for full-scale deflection. The level should be approximately 100 times than that required for direct input. Using the 60-db attenuator head, adjust the generator for full-scale deflection. The level should be approximately 1000 times that required for direct input. Set the generator output for full-scale deflection on the crt. Maintaining a constant amplitude input to the probe, vary the generator frequency from 0.5 mc to 13.5 mc (to 23.5 mc with the SPA-3/25), using the CENTER FREQUENCY dial to keep the pip at the center of the screen. The amplitude variation of the pip should not be greater than ±3 db.

o. SPARE FUSES AND TOOLS.

Check that two 3-a, 250-v cartridge fuses are mounted on the rear apron of the Model PS-19 chassis. Check that the following tools are mounted on the rear apron of the analyzer-section chassis.

1--#4 Key for multiple-spline socket screw.
1--#6 Key for 4-point-spline socket screw.
1--#8 Key for multiple-spline socket screw.
1--Walsco #2543 alignment tool.
1--Cambridge Thermionic #X2033 Alignment tool.

CHAPTER VI
ACCESSORY EQUIPMENT

INTRODUCTION

This chapter contains information regarding accessory equipment which can be used with the Panoramic Spectrum Analyzer, Model SPA-3 and SPA-3/25.

No attempt to operate the accessory equipment should be made until the user is thoroughly familiar with the entire operating procedure.

VI-1. CATHODE FOLLOWER PROBE, MODEL PRB-1a

a. GENERAL DESCRIPTION

The Cathode Follower Probe, Model PRB-1a, permits connection of signals from a high-impedance source to the Panoramic Spectrum Analyzer, Model SPA-3 or SPA-3/25.

The complete probe consists of a cathode-follower section (with attached r-f and power cables), a UHF-to-BNC adapter (usually shipped attached to the r-f cable), three attenuator heads (a 20-db head, a 40-db head, and a 60-db head), and three test points (a straight point, a hooked point, and an alligator-clip point).

b. SPECIFICATIONS.

Frequency response, 1 kc to 23.5 mc (without attenuator head)	±3 db
Insertion loss	10 db (approximate)
Input impedance (less attenuator heads)*	12 megohms shunted by 5 uuf

NOTE

Low frequency response drops off appreciably at low frequency when using attenuator head.

Maximum permissible total rms input voltage

Probe less attenuator head	1 volt
20-db attenuator head (single gold band)	1 volt
40-db attenuator head (double gold band)	10 volts
60-db attenuator head (triple gold band)	100 volts

c. INSTALLATION

Connect the 4 contact plug to the PROBE receptacle on the SPA-3 or SPA-3/25 front panel. The r-f cable is attached to the BNC connector of the INPUT receptacle on the Analyzer front panel using the UHF to BNC adapter supplied.

As determined by the signal levels involved (see SPECIFICATIONS), the probe is used without attenuator head or with one of the three supplied attenuator heads. The attenuator heads screw on to the cathode-follower section. Note that to indicate attenuation, the attenuator heads are banded. The single-gold-banded head has an attenuation of 20 db. The double-gold-banded head has an attenuation of 40 db. The triple-gold-banded head has an attenuation of 60 db. For convenience, three different test points are supplied. They screw on to the cathode-follower section (when used without attenuator head) or the attenuator head.

The probe test tip is connected to the signal source. Be sure to connect the ground clip of the probe to the ground side of the signal source.

CAUTION

Be sure that the maximum input-signal levels to the probe are not exceeded or harmonics of the input signal will be generated.

The normal overload conditions for the Models SPA-3 and SPA-3/25 apply when the probe is connected. See III-4a(2).

d. CIRCUIT DESCRIPTION.

The cathode follower is a type 5718 triode whose cathode load is the 72-ohm resistance of the spectrum analyzer input circuit. Plate and heater voltages for the tube are provided through the 4-contact plug which is connected to the spectrum analyzer.

The attenuator heads are simple capacitive divider attenuators.

e. SERVICE AND MAINTENANCE.

(1) Troubleshooting.

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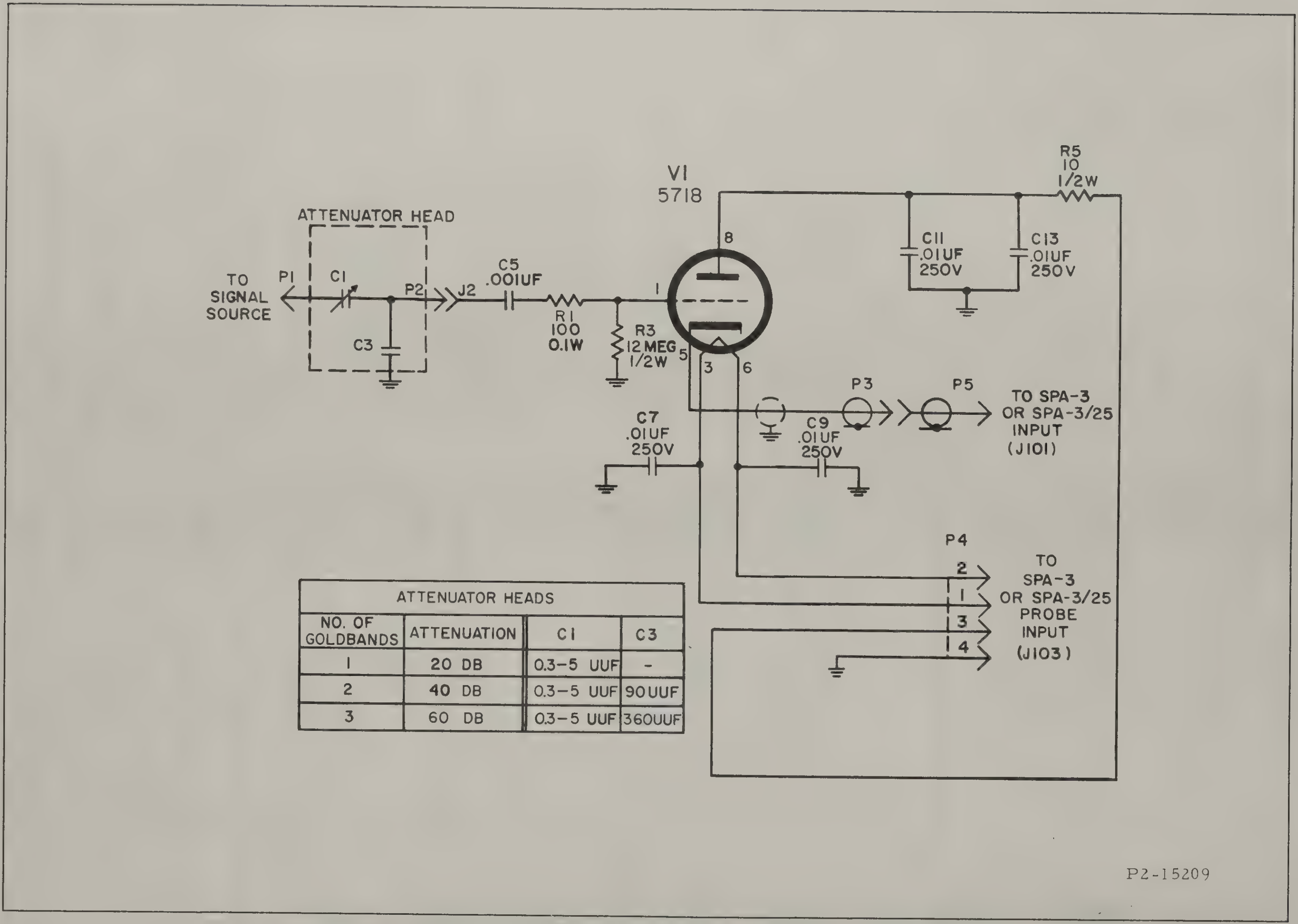
* The input impedance will depend on the attenuator head being used.


TO
SIGNAL
SOURCE
P1
ATTENUATOR HEAD
C1
C3
P2
J2
C5
.001UF
R1
100
0.1W
R3
12 MEG
1/2W
V1
5718
1
8
5
3
6
C11
.01UF
250V
C13
.01UF
250V
R5
10
1/2W
C7
.01UF
250V
C9
.01UF
250V
P3
P5
TO SPA-3
OR SPA-3/25
INPUT
(J101)
P4
2
1
3
4
TO
SPA-3
OR SPA-3/25
PROBE
INPUT
(J103)
P2-15209

ATTENUATOR HEADS			
NO. OF GOLDBANDS	ATTENUATION	C1	C3
1	20 DB	0.3–5 UUF	-
2	40 DB	0.3–5 UUF	90 UUF
3	60 DB	0.3–5 UUF	360 UUF

Figure VI-1. Schematic Diagram, Cathode-Follower Probe, Model PRB-1a.

SYMPTOM	CORRECTIVE MEASURES
No output	If probe does not get warm: 1. Check voltages at J103. 2. Check filament of probe tube for continuity. 3. Check probe plug for broken leads.
No output using Attenuator Head	Remove head, apply signal directly into probe to determine whether or not the head is defective.
Incorrect output using Attenuator Head	Realign head per paragraph (2) below.

(2) Alignment Procedure.

(a) 20-DB Attenuator Head.

i. Adjust the spectrum analyzer controls for maximum sensitivity and the CENTER FREQUENCY dial to 2 MC. Connect the probe, without any attenuator head, to the input of the analyzer.

ii. Connect a signal generator (with accurate means of changing and measuring relative level) to the input of the probe. Set the generator frequency to 2 mc. Be sure the generator is connected to the probe through the normal generator output termination. Adjust the generator level for a full-scale pip on the analyzer and note the generator level.

iii. With the 20-db attenuator head installed, increase the generator output 10 times. If required, adjust the probe for a full-scale pip on the analyzer crt. This is done by an adjusting screw in the tip of the attenuator head. A jeweler's screwdriver is required and is supplied with the probe.

(b) 40-DB Attenuator Head.

i. Replace the 20-db attenuator head with the 40-db attenuator head.

ii. Increase the generator output to 100 times the output required for full-scale deflection without attenuator head. If required, adjust the probe for a full scale pip on the analyzer crt.

(c) 60-DB Attenuator Head.

i. Replace the 40-db attenuator head with the 60-db attenuator head.

ii. Increase the generator output to 1000 times the output required for full-scale deflection without attenuator head. If required, adjust the probe output for a full-scale pip on the analyzer crt.

(3) Voltage and Resistance Chart.

Meter Readings on R.C.A. Volt-Ohmyst WV-77A
Probe PRB-1a
J103

Voltage pin	#1	4.6 VAC
	#2	0.0 V
	#3	90 VDC (with probe connected)
	3	250 VDC (without probe)
	#4	0.0 V

Resistance Pin	#1	Less than .1 ohm
	#2	Less than .1 ohm
	#3	20,000 ohms
	#4	0 ohm

CHAPTER VII

LIST OF REPLACEABLE PARTS

VII-1. INTRODUCTION

a. This list is divided into four sections. The first section covers the Analyzer, Model SPA-3 and Model SPA-3/25. The second section covers the Power Supply, Model PS-19.

b. In the case where an item appears more than once, the total quantity is listed only once per section in the "quantity in set" column. It is listed the first time the item appears in each section.

c. Absence of model number after circuit reference symbol indicates component is used in both SPA-3 and SPA-3/25. "Quantity in Set" is quantity for the SPA-3 and also for the SPA-3/25.

d. A model number after the circuit reference symbol designates only that set which uses the component. The quantity is the total for that set.

e. A list of Manufacturers' Code Letters used in this list is given on the last page of this chapter.

f. In some cases, the values, ratings and source (manufacturer) shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement for the part removed from the equipment.

When ordering parts from the factory, always include the following information:

1. Instrument Model Number
2. Instrument Serial Number
3. Circuit Reference Symbol
4. Description of Part
5. Panoramic Part Number

VII-2. LIST OF REPLACEABLE PARTS

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C103		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0	16	
C105		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C106		CAPACITOR: tubular, fixed paper, .25 uf, 400 V Pan Part CT2020-4	AJ PJ4P25	2	
C107		CAPACITOR: variable, piston type, 1-18 uuf Pan Part CV2099	AR VC-4G	3	
C108		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C109		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C110		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C111		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C115		CAPACITOR: variable, piston type, 1-18 uuf Pan Part CV2099	AR VC-4G		
C117		CAPACITOR: variable, piston type, 1-18 uuf Pan Part CV2099	AR VC-4G		
C119		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C121		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C123		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z	35	
C125		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C127		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C129		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C131		CAPACITOR: variable, piston type, 1-5 uuf Pan Part CV2051	AR VC-5	1	
C133		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C135		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C136		CAPACITOR: fixed, ceramic feed thru, 1000 uuf, ±20% 500 V Pan Part CC2138-13	AM GP(SL) 327-1000 ±200 uuf	6	
C137 A,B C,D		CAPACITOR: fixed, electrolytic, twistlock, 4 x 40 uf, 450 V Pan Part CE34X400R-1	AW TVL4775	1	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C139		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C141		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C143		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C145		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C147		CAPACITOR: fixed, composition, 2.2 uuf, 500 V, ±10% Pan Part CC1270-15	AN Type GA	1	
C149		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C151		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C153		CAPACITOR: fixed, silvered mica, 51 uuf, ±5%, 300 V Pan Part CM15C510J	AL CM15C510J	1	
C155		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C157		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C159		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C161		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C162		CAPACITOR: fixed, ceramic feed thru, 1500 uuf, ±20%, 500 V Pan Part CC2161-13	AM 357-152		
C163		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C164		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C165		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C167		CAPACITOR: variable, ceramic trimmer, 8-50 uuf Pan Part CV2022	AF Type N-650 822AN	3	
C169		CAPACITOR: fixed, silvered mica, 15 uuf, ±5%, 300 V Pan Part CM15C150J	AL CM15C150J	1	
C171		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C173		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A	23	
C175		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C177		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C179		CAPACITOR: variable, ceramic trimmer, 8-50 uuf Pan Part CV2022	AF Type N-650 822AN		
C181		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C183		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C185		CAPACITOR: variable, ceramic trimmer, 8-50 uuf Pan Part CV2022	AF Type N-650 822AN		
C187		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C189		CAPACITOR: fixed, silvered mica, 20 uuf, ±5%, 300 V Pan Part CM15C200J	AL CM15C200J	3	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C191		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C193		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC20055-1	AW 29C187A		
C195		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C197		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%, 300 V Pan Part CM20C101J	AL CM20C101J	5	
C199		CAPACITOR: fixed, silvered mica, 270 uuf, ±5%, 300 V Pan Part CM15C271J	AL CM15C271J	1	
C203		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C204		CAPACITOR: fixed, silvered mica, 470 uuf, ±5%, 300 V Pan Part CM15C471J	AL CM15C471J	3	
C207		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C209		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%, 500 V Pan Part CM20C101J	AL CM20C101J		
C211		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C213		CAPACITOR: fixed, mylar 1000 uuf, 400 V Pan Part CT2094-5	AP 338E102M	1	
C215		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%, 500 V Pan Part CM20C101J	AL CM20C101J		
C217		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C219		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C220		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C221		CAPACITOR: fixed, silvered mica, 240 uuf, ±5%, 500 V Pan Part CM20C241J	AL CM20C241J	1	
C223		CAPACITOR: fixed, silvered mica, 75 uuf, ±5%, 300 V Pan Part CM15E750J	AL CM15E750J	1	
C225		CAPACITOR: fixed, silvered mica, 750 uuf, ±5%, 300 V Pan Part CM20C751J	AL CM20C751J	1	
C227		CAPACITOR: fixed, mylar, .22 uf, 400 V Pan Part CT2151-5	AP 338E224M	1	
C229		CAPACITOR: fixed, molded tubular, .1 uf, 200 V Pan Part CT-2038-1	AW 2TM-P1	1	
C231		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C233		CAPACITOR: fixed, silvered mica, 10 uuf, ±5%, 500 V Pan Part CM20C100J	AL CM20C100J	1	
C235		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C237		CAPACITOR: fixed, silvered mica, 470 uuf, ±5%, 500 V Pan Part CM20C471J	AL CM20C471J	1	
C238	SPA-3/25	CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z	2	
C239		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%, 500 V Pan Part CM20C101J	AL CM20C101J		
C240	SPA-3/25	CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C241		CAPACITOR: fixed, silvered mica, 100 uuf, ±5%, 500 V Pan Part CM20C101J	AL CM20C101J		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C243		CAPACITOR: fixed, silvered mica, 510 uuf, ±5%, 500 V Pan Part CM20E511J	AL CM20E511J	1	
C245		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C247		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C249		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C251		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C253		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C255		CAPACITOR: fixed, silvered mica, 430 uuf, ±5%, 300 V Pan Part CM15C431J	AL CM15C431J	2	
C257		CAPACITOR: fixed, silvered mica, 430 uuf, ±5%, 300 V Pan Part CM15C431J	AL CM15C431J		
C259		CAPACITOR: fixed, silvered mica, 470 uuf, ±5%, 300 V Pan Part CM15C471J	AL CM15C471J		
C261		CAPACITOR: fixed, silvered mica, 470 uuf, ±5%, 300 V Pan Part CM15C471J	AL CM15C471J		
C262		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V, ±20% Pan Part CC2003-2	BG CD16XD103Z		
C263		CAPACITOR: variable, ceramic NPO trimmer, 1.5 to 7 uuf Pan Part CV2140J-14	AF 822-E2	1	
C265 A,B		CAPACITOR: dual, variable, air dielectric, 6.5 - 51 uuf Pan Part CV2002	AK 167-52	1	
C267		CAPACITOR: adjustable, air trimmer, 2-3 uuf Pan Part CV1247M	AE PL6000	1	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C269		CAPACITOR: fixed, silvered mica, 20 uuf, ±5%, 300 V Pan Part CM15C200J	AL CM15C200J		
C270	SPA-3/25	CAPACITOR: fixed, silvered mica, 20 uuf, ±5%, 300 V factory selected Pan Part CM15C200J	AL CM15C200J	1	
C271		CAPACITOR: fixed, silvered mica, 20 uuf, ±5%, 300 V Pan Part CM15C200J	AL CM15C200J		
C273		CAPACITOR: fixed, silvered mica, 47 uuf, ±5%, 300 V Pan Part CM15C470J	AL CM15C470J	1	
C275		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C277		CAPACITOR: fixed, silvered mica, 1000 uuf, ±5%, 300 V Pan Part CM20C102J	AL CM20C102J	3	
C279		CAPACITOR: fixed, silvered mica, 1000 uuf, ±5%, 300 V Pan Part CM20C102J	AL CM20C102J		
C281		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C283		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C285		CAPACITOR: fixed, mylar 4700 uuf, 400 V Pan Part CT2132-5	AP 338E472M	1	
C287		CAPACITOR: fixed, ceramic disc, .01 uf, ±20%, 500 V Pan Part CC2003-2	BG CD16XD103Z		
C289		CAPACITOR: fixed, molded tubular, .022 uf, 400 V Pan Part CT2170-1	AW 4TM-S22	1	
C291		CAPACITOR: fixed, silvered mica, 91 uuf, ±5%, 500 V Pan Part CM20C910J	AL CM20C910J	1	
C292		CAPACITOR: fixed, silvered mica, 1000 uuf, ±5%, 300 V Pan Part CM20C102J	AL CM20C102J		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C293		CAPACITOR: fixed, molded tubular, .25 uf, 400 V Pan Part CT2020-4	AJ 4P25		
C295		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C297		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C299		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C301		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C303		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C305		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C307		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C309		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C311		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C313		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C315		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C317		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C319		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C321		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C323		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C325		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AW 29C187A		
C326		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C327		CAPACITOR: fixed, electrolytic, twistlock, 2000 uf, 15 V Pan Part CE31X202E-1	AW TVL1168	1	
C328		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC2123-13	AM 827200Z5V0		
C329		CAPACITOR: fixed, silvered mica, 200 uuf, ±5%, 300 V Pan Part CM15E201J	AT CM15E201J	1	
C331		CAPACITOR: fixed, ceramic feed thru, 1500 uuf, ±20%, 500 V Pan Part CC2161-13	AM 357-152		
C333		CAPACITOR: fixed, ceramic feed thru, 1500 uuf, ±20%, 500 V Pan Part CC2161-13	AM 357-152		
C335		CAPACITOR: fixed, ceramic feed thru, 1500 uuf, ±20%, 500 V Pan Part CC2161-13	AM 357-152		
C337		CAPACITOR: fixed, ceramic feed thru, 1500 uuf, ±20%, 500 V Pan Part CC2161-13	AM 357-152		
C501*		CAPACITOR: fixed, silvered mica, 120 uuf, ±5%, 300 V, factory selected Pan Part CM15C121J	AL CM15C121J	1	

* 72 ohm input

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C501**		CAPACITOR: fixed, silvered mica, 120 uuf, ±5%, 300 V factory selected Pan Part CM15C121J	AL CM15C121J		
C505		CAPACITOR: fixed, ceramic disc, .05 uuf, 500 V Pan Part CC-2123-13	AM 827200Z5V0		
CR101		RECTIFIER: selenium, bridge 1.5 amp, 26 VAC, 4 cell Pan Part CR2021	AU C11S1B1S1G	1	
CR102		DIODE: germanium Pan Part CR1N128	AU 1N128	1	
DS101		LAMP: incandescent Pan Part B1007	AO 47	1	
DS102		LAMP: miniature, type #349 6.3 V, .206 amps Pan Part B2106	AO 349	4	
DS103		LAMP: miniature, type #349 6.3 V, .206 amps Pan Part B2106	AO 349		
DS104		LAMP: miniature, type #349 6.3 V, .206 amps Pan Part B2106	AO 349		
DS105		LAMP: miniature, type #349 6.3 V, .206 amps Pan Part B2106	AO 349		
DS106	SPA-3/25	LAMP: indicator, miniature, light yellow, neon, hot stamp "LO" Pan Part B2079	BC 38-1536	1	
DS107	SPA-3/25	LAMP: indicator, miniature red neon, hot stamp "H" Pan Part B2080	BC 38-1531	1	
E101		LAMP: neon, 1/4 W, double contact, bayonet, candelabra Pan Part B2026M	AT Type NE-16 C1-9064	1	
J103		CONNECTOR: receptacle, 4 contact, female, microphone type Pan Part J2071	AB 91PC4F	1	
J105		CONNECTOR: receptacle, BNC D type, MIL type, UG-1094/U Pan Part J2031	AB 31-221	8	

**50 ohm input

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
J107		CONNECTOR: receptacle, BNC D type, MIL type, UG-1094/U Pan Part J2031	AB 31-221		
J109		CONNECTOR: jack, telephone, two conductor, open circuit Pan Part J2061	AD 257	1	
J111		CONNECTOR: post, binding Pan Part J2035	AK 111-103	4	
J113		CONNECTOR: receptacle, 12 pin, female Pan Part J2063	AE M12S-LS12-N	1	
J115		CONNECTOR: jack, tip, red Pan Part X2054R	BH SKT-8(Red)	1	
J117		CONNECTOR: receptacle, BNC D type, MIL type, UG-1094/U Pan Part J-2031	AB 31-221	6	
J119		CONNECTOR: receptacle, D type, MIL type, UG-1094/U Pan Part J2031	AB 31-221		
J121		CONNECTOR: receptacle, BNC D type, MIL type, UG-1094/U Pan Part J2031	AB 31-221		
J123		CONNECTOR: receptacle, BNC D type, MIL type, UG-1094/U Pan Part J2031	AB 31-221		
J125		CONNECTOR: receptacle, BNC D type, MIL type, UG-1094/U Pan Part J2031	AB 31-221		
J129		RECEPTACLE: 10 pin, female Pan Part J2023	AB MS3102A-18-15	1	
J130		CONNECTOR: post binding Pan Part J2035	AK 111-103		
J131		RECEPTACLE: 14 pin, male Pan Part P2006	AB MS3102A-28-2P	1	
J501		CONNECTOR: receptacle, BNC D type, MIL type, UG-1094/U Pan Part J2031	AB 31-221		
J502		CONNECTOR: receptacle, BNC, MIL type, UG-1098/U, right angle Pan Part J2072	AB 31-222	1	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
L101		CHOKE: r-f, 2.7 uh, ±10% Pan Part L2053	BB 210-11	1	
L102		CHOKE: r-f, 6.8 uh, ±10% Pan Part L2054	BB 215-11		
L103		CHOKE: r-f, 3.3 uh, ±10% Pan Part L2038	BB 211-11	2	
L104		CHOKE: r-f, 10 uh, ±10% Pan Part L2055	BB 217-21	1	
L105		CHOKE: r-f, 3.3 uh, ±10% Pan Part L2038	BB 211-11		
L107		CHOKE: r-f, 100 uh Pan Part L1112	AX CH-3-3	6	
L109		COIL: oscillator, 29.3 mc Pan Part ZN-8376	AT Z2-8376A	1	
L110		CHOKE: r-f, 100 uh Pan Part L1112	AX CH-3-3		
L111		COIL: crystal loading, 2.7 mc Pan Part ZN-8377	AT Z2-8377B	2	
L113		CHOKE: r-f, 100 uh Pan Part L1112	AX CH-3-3		
L115		CHOKE: r-f, 100 uh Pan Part L1112	AX CH-3-3		
L117		COIL: crystal loading, 2.7 mc Pan Part ZN-8377	AT Z2-8377B		
L119		CHOKE: r-f, 100 uh Pan Part L1112	AX CH-3-3		
L121		CHOKE: r-f, 0.8 uh Pan Part L2051-1 or -2	AS 6175-TV or AX CH-11-8	10	
L123		CHOKE: r-f, 0.8 uh Pan Part L2051 - 1 or -2	AS 6175-TV or AX CH-11-8		
L125		CHOKE: r-f, 100 uh Pan Part L1112	AX CH-3-3		
L127		INDUCTOR: Vari-L 32 - 55.5 mc Pan Part L2049A	AZ SD-36A	1	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
L129		COIL: oscillator, variable Pan Part ZN-8375	AT Z2-8375A	1	
L130		CHOKE: r-f, 0.8 uh Pan Part L2051 -1 or -2	AS 6175-TV or AX CH-11-8		
L131		CHOKE: r-f, 0.8 uh Pan Part L2051 -1 or -2	AS 6175-TV or AX CH-11-8		
L133		CHOKE: r-f, 0.8 uh Pan Part L2051 -1 or -2	AS 6175-TV or AX CH-11-8		
L135		CHOKE: r-f, 0.8 uh Pan Part L2051 -1 or -2	AS 6175-TV or AX CH-11-8		
L137		CHOKE: r-f, 24 uh, 300 ma, .28 ohms Pan Part L2052	AS 4626	2	
L139		CHOKE: r-f, 24 uh, 300 ma, .28 ohms Pan Part L2052	AS 4626		
L141		CHOKE: r-f, 0.8 uh Pan Part L2051 -1 or -2	AS 6175-TV or AX CH-11-8		
L143		CHOKE: r-f, 0.8 uh Pan Part L2051 -1 or -2	AS 6175-TV or AX CH-11-8		
L145		CHOKE: r-f, 0.8 uh Pan Part L2051-1 or -2	AS 6175-TV or AX CH-11-8		
L147		CHOKE: r-f, 0.8 uh Pan Part L2051 -1 or -2	AS 6175-TV or AX CH-11-8		
P105		CONNECTOR: plug, r-f, UG260/U Pan Part P2010	AB 31-012	6	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
P107		CONNECTOR: plug, r-f, UG260/U Pan Part P2010	AB 31-012		
P113		CONNECTOR: plug, 12 contact, male, Pan Part 2102B Hood and lock shell Pan Part P2102A	AE M12P & M12H	1	
P117		CONNECTOR: plug, r-f, UG260/U Pan Part P2010	AB 31-012		
P119		CONNECTOR: plug, r-f, UG260/U Pan Part P2010	AB 31-012		
P121		CONNECTOR: plug, r-f, UG260/U Pan Part P2010	AB 31-012		
P129		PLUG, 10 pin, male Pan Part P2036	AB MS3106A18-1P		
R502		RECEPTACLE: BNC, MIL type, UG260/U Pan Part P2010	AB 31-012		
R119		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045	12	
R121		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R127		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225	6	
R131		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1/2 W Pan Part RC20BX683J	AA EB6835	2	
R132		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 2 W Pan Part RC42BX333J	AA HB3335	2	
R133		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025	6	
R134		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 2 W Pan Part RC42BX333J	AA HB3335		

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R135		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R136		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W Pan Part RC20BX244J	AA EB2445	3	
R137		RESISTOR: fixed, composition, factory selected, 560 ohms, ±5%, 1/2 W, nominal value* Pan Part RC20BX561J	AA EB5615		
R138		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W Pan Part RC20BX244J	AA EB2445		
R139		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R140		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015	10	
R141		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1 W Pan Part RC32BX222J	AA GB2225	1	
R142		RESISTOR: fixed, composition, factory selected, 1,000 ohms, ±5%, 1/2 W, nominal value* Pan Part RC20BX102J	AA EB1025		
R143		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R144		RESISTOR: fixed, composition, 30,000 ohms, ±5%, 1 W Pan Part RC32BX303J	AA GB3035	1	
R145		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R146		RESISTOR: fixed, composition, 10 ohms, ±5%, 1/2 W Pan Part RC20BX100J	AA EB1005	1	
R147		RESISTOR: fixed, composition, 620 ohms, ±5%, 1/2 W Pan Part RC20BX621J	AA EB6215	3	

* for actual value, see schematic diagram.

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R149		RESISTOR: fixed, composition, 620 ohms, ±5%, 1/2 W Pan Part RC20BX621J	AA EB6215		
R151		RESISTOR: fixed, composition, 200,000 ohms, ±5%, 1/2 W Pan Part RC20BX204J	AA EB2045	3	
R153		RESISTOR: fixed, composition, 200,000 ohms, ±5%, 1/2 W Pan Part RC20BX204J	AA EB2045		
R155		RESISTOR: fixed, composition, 1,800 ohms, ±5%, 1/2 W Pan Part RC20BX182J	AA EB1825	2	
R157		RESISTOR: fixed, composition, 1,800 ohms, ±5%, 1/2 W Pan Part RC20BX182J	AA EB1825		
R159		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1/2 W Pan Part RC20BX753J	AA EB7535	1	
R161		RESISTOR: variable, composition, linear, 50,000 ohms, ±10%, 2 W Pan Part RV035	AT RV2-22035	2	
R163		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 1/2 W Pan Part RC20BX243J	AA EB2435	1	
R165		RESISTOR: fixed, composition, 13,000 ohms, ±5%, 1/2 W Pan Part RC20BX133J	AA EB1335	1	
R167		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045	5	
R169		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225		
R171		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W Pan Part RC20BX511J	AA EB5115	2	
R173		RESISTOR: variable, composition, linear, 10,000 ohms, ±10%, 2 W Pan Part RV005	AT RV2-22005	2	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R175		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W Pan Part RC20BX511J	AA EB5115		
R177		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R179		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 2 W Pan Part RC42BX102J	AA HB1025	1	
R181		RESISTOR: variable, composition, linear, 1,000 ohms, ±10%, 2 W Pan Part RV018	AT RV2-22018	1	
R183		RESISTOR: fixed, composition, 12 ohms, ±5%, 1/2 W Pan Part RC20BX120J	AA EB1205	1	
R185		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W Pan Part RC20BX361J	AA EB3615	1	
R187		RESISTOR: variable, composition, linear, 10,000 ohms, ±10%, 2 W Pan Part RV005	AT RV2-22005		
R189		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1/2 W Pan Part RC20BX154J	AA EB1545	2	
R191		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AA GB4735	1	
R193		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AA EB5625	4	
R195		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R197		RESISTOR: fixed, wirewound, 4.7 ohms, ±10%, 1/2 W Pan Part RCW20AX4P7K-3	AQ Type BW-1/2	1	
R199		RESISTOR: fixed, composition, 6,200 ohms, ±5%, 1/2 W Pan Part RC20BX622J	AA EB6225	1	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R201		RESISTOR: fixed, composition, 18,000 ohms, ±5%, 1 W Pan Part RC32BX183J	AA GB1835	1	
R203		RESISTOR: fixed, composition, 22 ohms, ±5%, 1/2 W Pan Part RC20BX220J	AA EB2205	3	
R205		RESISTOR: fixed, composition, 3,900 ohms, ±5%, 1/2 W Pan Part RC20BX392J	AA EB3925	1	
R207		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AA EB2215	1	
R211		RESISTOR: fixed, composition, 39,000 ohms, ±5%, 2 W Pan Part RC42BX393J	AA HB3935	1	
R213		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AA EB5625		
R215		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1/2 W Pan Part RC20BX474J	AA EB4745	3	
R217		RESISTOR: fixed, composition, 390 ohms, ±5%, 1/2 W Pan Part RC20BX391J	AA EB3915	2	
R219		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R221		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R223		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R225 A,B		RESISTOR: variable, dual cw log taper, 10,000 ohms, ±10% Pan Part RVT512	AT RV2-22512	1	
R227		RESISTOR: fixed, composition, 200,000 ohms, ±5%, 1/2 W Pan Part RC20BX204J	AA EB2045		
R228		RESISTOR: fixed, composition, factory selected, 10,000 ohms, ±5%, 1/2 W, nominal value* Pan Part RC20BX103J	AA EB1035	3	

*For actual value, see schematic diagram.

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R229		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1/2 W Pan Part RC20BX154J	AA EB1545	2	
R230		RESISTOR: fixed, composition, 5,100 ohms, ±5%, 1/2 W Pan Part RC20BX512J	AA EB5125	1	
R231		RESISTOR: fixed, composition, 160 ohms, ±5%, 1/2 W Pan Part RC20BX161J	AA EB1615	3	
R233		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R235		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R237		RESISTOR: fixed, composition, 390 ohms, ±5%, 1/2 W Pan Part RC20BX391J	AA EB3915		
R239		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R241		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R243		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R245		RESISTOR: fixed, composition, factory selected, 10,000 ohms, ±5%, 1/2 W, nominal value* Pan Part RC20BX103J	AA EB1035		
R247		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225		
R249		RESISTOR: fixed, composition, 120,000 ohms, ±5%, 1/2 W Pan Part RC20BX124J	AA EB1245	1	
R251		RESISTOR: fixed, composition, 160 ohms, ±5%, 1/2 W Pan Part RC20BX161J	AA EB1615		
R253		RESISTOR: fixed, composition, 160 ohms, ±5%, 1/2 W Pan Part RC20BX161J	AA EB1615		

*for actual value, see schematic diagram.

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R255		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R257		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R259		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R261		RESISTOR: variable, composition, linear, 100,000 ohms, ±10%, 2 W Pan Part RV025	AA RV2-22025	3	
R263		RESISTOR: fixed, composition, factory selected, 43,000 ohms, ±5%, 1 W, nominal value* Pan Part RC32BX433J	AA GB4335		
R265		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1 W Pan Part RC32BX333J	AA GB3335	1	
R267		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1 W Pan Part RC32BX562J	AA GB5625	2	
R269		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 2 W Pan Part RC42BX473J	AA HB4735	1	
R271		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1 W Pan Part RC32BX562J	AA GB5625		
R273		RESISTOR: fixed, composition, 20,000 ohms, ±5%, 1 W Pan Part RC32BX203J	AA GB2035	1	
R275		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055	7	
R277		RESISTOR: fixed, composition, 750 ohms, ±5%, 1/2 W Pan Part RC20BX751J	AA EB7515	1	
R278		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1/2 W Pan Part RC20BX683J	AA EB6835		

*for actual value, see schematic diagram.

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R279		RESISTOR: variable, composition, linear, 100,000 ohms, ±10%, 2 W Pan Part RV025	AT RV2-22025		
R281		RESISTOR: fixed, composition, 11,000 ohms, ±5%, 1/2 W Pan Part RC20BX113J	AA EB1135	1	
R283		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245	5	
R285		RESISTOR: fixed, composition, 680,000 ohms, ±5%, 1/2 W Pan Part RC20BX684J	AA EB6845	1	
R287		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R289		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225		
R291		RESISTOR: fixed, composition, 4,700 ohms, ±5%, 1/2 W Pan Part RC20BX472J	AA EB4725	1	
R293		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R295		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1/2 W Pan Part RC20BX154J	AA EB1545		
R297		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225		
R299		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225		
R301		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R303		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055		
R305		RESISTOR: fixed, composition, 4,300 ohms, ±5%, 1/2 W Pan Part RC20BX432J	AA EB4325	1	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R307		RESISTOR: variable, composition, linear (includes switch S107) 5 megohms, ±20%, 2 W Pan Part RVS704	AT RV2-22704	1	
R309		RESISTOR: fixed, composition, 4.7 megohms, ±5%, 1/2 W Pan Part RC20BX475J	AA EB4755	1	
R311		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC20BX104J	AA GB1045		
R313		RESISTOR: fixed, composition, 620 ohms, ±5%, 1/2 W Pan Part RC20BX621J	AA EB6215		
R315		RESISTOR: fixed, composition, 120 ohms, ±5%, 1/2 W Pan Part RC20BX121J	AA EB1215	1	
R317		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC20BX104J	AA GB1045		
R319		RESISTOR: fixed, composition, 1.2 megohms, ±5%, 1/2 W Pan Part RC20BX125J	AA EB1255	1	
R321		RESISTOR: fixed, composition, 160,000 ohms, ±5%, 1/2 W Pan Part RC20BX164J	AA EB1645	1	
R323		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AA EB5625		
R325		RESISTOR: variable, composition, linear, 500,000 ohms, ±10%, 2 W Pan Part RV015	AT RV2-22015	3	
R327		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1 W Pan Part RC32BX683J	AA GB6835	1	
R329		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1 W Pan Part RC32BX154J	AA GB1545	1	
R331		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1/2 W Pan Part RC20BX474J	AA EB4745		
R333		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R335		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055		
R337		RESISTOR: variable, composition, linear (includes switch S104), 1,000 ohms, ±10%, 2 W Pan Part RVS703	AT RV2-22703	1	
R339		RESISTOR: fixed, wirewound, radial leads, 2,000 ohms, ±10%, 10 W Pan Part RW10X202R-6	AY FRL-10	1	
R341	(SPA-3)	RESISTOR: fixed, composition, factory selected, 91,000 ohms, ±5%, 1/2 W, nominal value* Pan Part RC20BX913J	AA EB9135	1	
R342	(SPA-3/25)	RESISTOR: fixed, composition, factory selected, 27 K, ±5%, 1/2 W, nominal value* Pan Part RC20BX273J	AA EB2735	1	
R343	(SPA-3/25)	RESISTOR: fixed, composition, factory selected, 180 K, ±5%, 1/2 W, nominal value* Pan Part RC20BX184J	AA EB1845	1	
R344	(SPA-3/25)	RESISTOR: fixed, composition, factory selected, 120 K, ±5%, 1/2 W, nominal value* Pan Part RC20BX124J	AA EB1205	1	
R345		RESISTOR: variable, composition, linear, 250,000 ohms, ±10%, 2 W Pan Part RV024	AT RV2-22024	1	
R347		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W Pan Part RC20BX244J	AA EB2445		
R349		RESISTOR: variable, composition, clockwise, log A taper, 100,000 ohms, ±10%, 2 W Pan Part RV034	AT RV2-22034	1	
R351		RESISTOR: fixed, composition, 200 ohms, ±5%, 1 W Pan Part RC32BX201J	AA GB2015	1	
R353		RESISTOR: variable, composition, linear, 300 ohms, ±10% 2 W Pan Part RV008	AT RV2-22008	1	

*for actual value, see schematic diagram.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R355		RESISTOR: fixed, composition, 51 ohms, ±5%, 1 W Pan Part RC32BX510J	AA GB5105	1	
R357		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1/2 W Pan Part RC20BX153J	AA EB1535	1	
R359		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135	3	
R361		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135		
R363		RESISTOR: fixed, composition, 22 ohms, ±5%, 1/2 W Pan Part RC20BX220J	AA EB2205		
R365		RESISTOR: fixed, composition, 390,000 ohms, ±5%, 1/2 W Pan Part RC20BX394J	AA EB3945	1	
R367		RESISTOR: fixed, composition, 240 ohms, ±5%, 1/2 W Pan Part RC20BX241J	AA EB2415	1	
R369		RESISTOR: fixed, composition, 3,300 ohms, ±5%, 1/2 W Pan Part RC20BX332J	AA EB3325	2	
R371		RESISTOR: fixed, composition, 22 ohms, ±5%, 1/2 W Pan Part RC20BX220J	AA EB2205		
R373		RESISTOR: fixed, composition, 3.3 K ohms, ±5%, 1/2 W Pan Part RC20BX332J	AA EB3325		
R375		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R377		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055		
R379		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055		
R381		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R385		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055		
R386		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R387		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R389		RESISTOR: fixed, composition, 3,000 ohms, ±5%, 1/2 W Pan Part RC20BX302J	AA EB3025	1	
R391		RESISTOR: variable, composition, linear, 50,000 ohms, ±10%, 2 W Pan Part RV035	AT RV2-22035	5	
R393		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC20BX104J	AA GB1045		
R395		RESISTOR: fixed, composition, 20,000 ohms, ±5%, 1/2 W Pan Part RC20BX203J	AA EB2035	1	
R397		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1/2 W Pan Part RC20BX474J	AA EB4745		
R399		RESISTOR: fixed, composition, 820,000 ohms, ±5%, 1/2 W Pan Part RC20BX824J	AA EB8245	1	
R401 A,B		RESISTOR: variable, dual linear, 50,000 ohms, /5 megohms, ±10%, 2 W Pan Part RVT502	AT RV2-22502	1	
R403		RESISTOR: fixed, composition, 4,700 ohms, ±5%, 1/2 W Pan Part RC20BX473J	AA EB4725	1	
R405		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1 W Pan Part RC32BX153J	AA GB1535	2	
R407		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1 W Pan Part RC32BX153J	AA GB1535		
R409		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135		

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R411		RESISTOR: variable, composition, linear, 100,000 ohms, ±10%, 2 W Pan Part RV025	AT RV2-22025		
R413		RESISTOR: fixed, composition, 30,000 ohms, ±5%, 1/2 W Pan Part RC20BX303J	AA EB3035	1	
R415		RESISTOR: variable, composition, linear, 500,000 ohms, ±10%, 2 W Pan Part RV015	AT RV2-22015		
R417		RESISTOR: variable, composition, linear, 500,000 ohms, ±10%, 2 W Pan Part RV015	AT RV2-22015		
R419		RESISTOR: fixed, composition, 750,000 ohms, ±5%, 1/2 W Pan Part RC20BX754J	AA EB7545	1	
R421		RESISTOR: variable, composition, linear, 1 megohm, ±20%, 2 W Pan Part RV002	AT RV2-22002	1	
R423	SPA-3/25	RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045	1	
R425		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055		
R427		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC20BX104J	AA GB1045		
R429		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035	1	
R431		RESISTOR: variable, composition, linear, 5,000 ohms, ±10%, 2 W Pan Part RV012	AT RV2-22012	1	
R433		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R435		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R437		RESISTOR: fixed, composition, 1.8 megohms, ±5%, 1/2 W Pan Part RC20BX185J	AA EB1855	1	
R439		RESISTOR: fixed, composition, 180,000 ohms, ±5%, 1/2 W Pan Part RC20BX184J	AA EB1845	1	
R441		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 2 W Pan Part RC42BX753J	AA HB7535	1	
R443		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AA EB5625		
R444		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1/2 W Pan Part RC20BX473J	AA EB4735	2	
R445		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R446		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1/2 W Pan Part RC20BX473J	AA EB4735		
R447		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 1 W Pan Part RC32BX243J	AA GB2435	1	
R448	(SPA-3/25)	RESISTOR: fixed, composition, 270,000 ohms, ±5%, 1/2 W Pan Part RC20BX274J	AA EB2745	1	
R449		RESISTOR: variable, composition, linear, 50,000 ohms, ±10%, 2 W Pan Part RV014	AT RV2-22014	1	
R451		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1 W Pan Part RC32BX753J	AA GB7535	1	
R453		RESISTOR: fixed, composition, 430,000 ohms, ±5%, 1/2 W Pan Part RC20BX434J	AA EB4345	1	
R455		RESISTOR: variable, composition, linear, high voltage, 100,000 ohms, ±30%, 2 W Pan Part RVX913	AG RV2-22913	1	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R457		RESISTOR: fixed, composition, 270,000 ohms, ±5%, 1 W Pan Part RC32BX274J	AA GB2745	1	
R459		RESISTOR: variable, composition, linear, high voltage, 500,000 ohms, ±30%, 2 W Pan Part RVX912	AG RV2-22912	1	
R461		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1 W Pan Part RC32BX474J	AA GB4745	2	
R463		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1 W Pan Part RC32BX474J	AA GB4745		
R465		RESISTOR: fixed, composition, 2,000 ohms, ±5%, 1/2 W Pan Part RC20BX202J	AA EB2025	2	
R467		RESISTOR: fixed, composition, 2,000 ohms, ±5%, 1/2 W Pan Part RC20BX202J	AA EB2025		
R469		RESISTOR: variable, wire-wound, linear, (includes switch S106) 6 ohms, ±10%, 2 W Pan Part RVS700	AT RV2-22700	1	
R501*		RESISTOR: fixed, precision, 73.4 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ73P4F-9	BD Type C1/2C	2	
R501**		RESISTOR: fixed, composition, precision, 51 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ51P0F-9	BD Type C1/2C	2	
R503*		RESISTOR: fixed, composition, 3600 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ3601F-9	BD Type C1/2C	1	
R503**		RESISTOR: fixed, composition, 2500 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ2510F-9	BD Type C1/2C	1	
R505*		RESISTOR: fixed, composition, 73.4 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ73P4F-9	BD Type C1/2C		

*72 ohm input
**50 ohm input

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R505**		RESISTOR: fixed, composition, 51 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ51P0F-9	BD Type C1/2C		
R507*		RESISTOR: fixed, composition, 88 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ88P0F-9	BD Type C1/2C	5	
R507**		RESISTOR: fixed, composition, 61.1 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ61P1F-9	BD Type C1/2C	4	
R509*		RESISTOR: fixed, composition, 356.4 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ365P4F-9	BD Type C1/2C	2	
R509**		RESISTOR: fixed, composition, 247.5 ohms, ±1%, 1/2 W customer order Pan Part RC20AZ247P5F-9	BD Type C1/2C	2	
R511*		RESISTOR: fixed, composition, 88 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ88P0F-9	BD Type C1/2C		
R511**		RESISTOR: fixed, composition, 61.1 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ61P1F-9	BD Type C1/2C		
R513*		RESISTOR: fixed, composition, 88 ohms, ±1%, 1/2 W customer order Pan Part RC20AZ88P0F-9	BD Type C1/2C		
R513**		RESISTOR: fixed, composition, 61.1 ohms, ±1%, 1/2 W customer option Pan Part RC20BX61P1F-9	BD Type C1/2C		
R515*		RESISTOR: fixed, composition, 356.4 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ365P4F-9	BD Type C1/2C		

* 72 ohm input
**50 ohm input

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R515**		RESISTOR: fixed, composition, 247.5 ohms, ±1%, 1/2 W customer order Pan Part RC20AZ247P5F-9	BC Type C1/2C		
R517*		RESISTOR: fixed, composition, 88 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ88P0F-9	BD Type C1/2C		
R517**		RESISTOR: fixed, composition, 61.1 ohms, ±1%, 1/2 W customer order Pan Part RC20AZ61P1F-9	BD Type C1/2C		
R519*		RESISTOR: fixed, composition, 200 ohms, ±1%, 1/2 W customer option Pan Part RC20AX2000F-9	BD Type C1/2C	1	
R519**		RESISTOR: fixed, composition, 88 ohms, ±1%, 1/2 W customer option Pan Part RC20AZ88P0F-9	BD Type C1/2C		
R521		RESISTOR: variable, composition, linear, 100 ohms, ±10%, 2 W Pan Part RV028	AT RV2-22028	1	
R523*		RESISTOR: fixed, composition, 5.6 ohms, ±1%, 1 W customer option Pan Part RC32AX5P6F-9	BD Type C1/2C	1	
R523**		RESISTOR: fixed, composition, 3.9 ohms, ±1%, 1 W Pan Part RC32AX3P9F-9	BD Type C1/2C	1	
S102		SWITCH: toggle, SPDT, bat handle Pan Part S2043	AC 81021-AV	1	
S103		SWITCH: rotary, ceramic wafer, single section, 3 pole, 3 throw Pan Part S19395B	AT S19395B	2	
S104		SWITCH: SPST See R337			
S105		SWITCH: rotary, ceramic wafer, single section, 3 pole, 3 throw Pan Part S2013	AT S1-2013		

* 72 ohm input
**50 ohm input

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
S106		SWITCH: rotary, ceramic, 5 pole, 1 section, 2 section Pan Part S2-11714	AT S2-11714	1	
S107		SWITCH: SPST See R307			
S501		SWITCH: toggle, DPDT Pan Part S2096	AC 83054	3	
S503		SWITCH: toggle, DPDT Pan Part S2096	AC 83054		
S505		SWITCH: toggle, DPDT Pan Part S2096	AC 83054		
T101		TRANSFORMER: I-F, 32 mc Pan Part ZN-8373D	AT Z2-8373	1	
T102		TRANSFORMER: I-F, 32 mc Pan Part ZN-8374D	AT Z2-8374	1	
T103		TRANSFORMER: I-F, 32 mc Pan Part ZN-8378	AT Z2-8378	1	
T104		TRANSFORMER: I-F, 2.7 mc Pan Part ZN-8379B	AT Z2-8379B	2	
T105		TRANSFORMER: I-F, 2.7 mc Pan Part ZN-8379B	AT Z2-8379B		
T106		TRANSFORMER: I-F, 2.7 mc Pan Part Z2-8473	AT Z2-8473	1	
V101		ELECTRON TUBE: 6BQ7A Pan Part 6BQ7A	BA 6BQ7A	1	
V102		ELECTRON TUBE: 6CB6 Pan Part 6CB6	BA 6CB6	2	
V103		ELECTRON TUBE: 6J6 Pan Part 6J6	BA 6J6	2	
V104		ELECTRON TUBE: 5879 Pan Part 5879	BA 5879	2	
V105		ELECTRON TUBE: 5879 Pan Part 5879	BA 5879		
V106		ELECTRON TUBE: 6AW8A Pan Part 6AW8A	BA 6AW8A	2	
V107		ELECTRON TUBE: 6BE6 Pan Part 6BE6	BA 6BE6	1	

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
V108		ELECTRON TUBE: 6AB4 Pan Part 6AB4	BA 6AB4	1	
V109		ELECTRON TUBE: 6AW8A Pan Part 6AW8A	BA 6AW8A		
V110		ELECTRON TUBE: 6CB6 Pan Part 6CB6	BA 6CB6		
V111		ELECTRON TUBE: 6AU6 Pan Part 6AU6	BA 6AU6	1	
V112		ELECTRON TUBE: 12AU7 Pan Part 12AU7	BA 12AU7	3	
V113		ELECTRON TUBE: 12AT7 Pan Part 12AT7	BA 12AT7	2	
V114		ELECTRON TUBE: 12AU7 Pan Part 12AU7	BA 12AU7		
V115		ELECTRON TUBE: 12AX7 Pan Part 12AX7	BA 12AX7	1	
V116		ELECTRON TUBE: OA2 Pan Part OA2	BA OA2	1	
V117		ELECTRON TUBE: 12BY7A Pan Part 12AY7A	BJ 12BY7A	1	
V118		ELECTRON TUBE: 6BK7A Pan Part 6BK7A	BA 6BK7A	1	
V119		ELECTRON TUBE: 6J6 Pan Part 6J6	BA 6J6		
V120		ELECTRON TUBE: 12AT7 Pan Part 12AT7	BA 12AT7		
V121		ELECTRON TUBE: 6U8 Pan Part 6U8	BA 6U8	1	
V122		ELECTRON TUBE: 12AU7 Pan Part 12AU7	BA 12AU7		
V123		ELECTRON TUBE: 5ADP7 Pan Part 5ADP7	BA 5ADP7	1	
Y101		CRYSTAL: quartz 29.300 mc, ±.005% Pan Part Y-3014	AT Y-3014	1	
Y102*		CRYSTAL: quartz, 2.700 mc, ±.005% Pan Part 2Y3015M	AT 2Y3015M	2	

*Supplied as a matched pair, Panoramic Part No. 2Y3015M

List of Replaceable Parts for Models SPA-3 and SPA-3/25 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
Y103*		CRYSTAL: quartz 2.700 mc, ±.005% Pan Part 2Y3015M	AT 2Y3015M		
Y104		CRYSTAL: quartz 500 kc, ±.01% Pan Part Y-3013	AT Y-3013	1	
		HEAD: attenuator, 20 db Pan Part AF-1001	AT AF-1001	1	
		HEAD: attenuator, 40 db Pan Part AF-1002	AT AF-1002	1	
		HEAD: attenuator, 60 db Pan Part AF-1003	AT AF-1003	1	
		PROBE: tip, pointed Pan Part E-2031	AT E-2031	1	
		PROBE: tip, hooked Pan Part E-2032	AT E-2032	1	
		PROBE: tip, alligator Pan Part E-2033	AT E-2033	1	
		TOOL: alignment Pan Part E-2022	AT E-2022	1	
		TOOL: alignment Pan Part E-2023	AT E-2023	1	

*Supplied as a matched pair, Panoramic Part No. 2Y3015M

List of Replaceable Parts for Power Supply, Model PS-19

Symbol Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C1		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC-2123-13	AM 827200Z5V0	2	
C2		CAPACITOR: fixed, ceramic disc, .05 uf, 500 V Pan Part CC-2123-13	AM 827200Z5V0		
C5		CAPACITOR: fixed, electrolytic, tubular, axial leads, 80 uf, 450 V Pan Part CE71X800R-1	AW TVA-1716	2	
C7		CAPACITOR: fixed, electrolytic, tubular, axial leads, 80 uf, 450 V Pan Part CE71X800R-1	AW TVA-1716		
C9		CAPACITOR: fixed, mylar, .1 uf, 400 V Pan Part CT2126-5	AP 338E104M	1	
C11		CAPACITOR: fixed, paper, molded, tubular, .5 uf, 400 V Pan Part CT-2061-10	AV 330405	1	
C13		CAPACITOR: fixed, electrolytic, twistlock, 40 uf, 450 V Pan Part CE31X400R-1	AW TVL-1725	1	
C15		CAPACITOR: fixed, electrolytic, tubular, axial leads, 20 uf, 450 V Pan Part CE71X200R-1	AW TVA-1709	2	
C17		CAPACITOR: fixed, electrolytic, tubular, axial leads, 20 uf, 450 V Pan Part CE71X200R-1	AW TVA-1709		
C19 A,B		CAPACITOR: fixed, paper, dielectric, 2 x 0.25 uf, 2500 V with ground lug Pan Part CP70D6XK254X-10	AP 7125-2X.25	2	
C21 A,B		CAPACITOR: fixed, paper, dielectric, 2 x 0.25 uf, 2500 V with ground lug Pan Part CP70D6XK254X-10	AP 7125-2X.25		
CR1		RECTIFIER: selenium, cartridge, 5 ma, 1000 V Pan Part CR-2008	AQ V50HF	1	
CR3		RECTIFIER: selenium, cartridge, 5 ma, 2000 V Pan Part CR-2005	AQ V100HF	2	

List of Replaceable Parts for Power Supply, Model PS-19 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
CR5		RECTIFIER: selenium, cartridge, 5 ma, 2000 V Pan Part CR-2005	AQ V100HF		
F1		FUSE: instantaneous, glass cartridge, 3 amp, 250 V Pan Part F-2009	AT F-2009	2	
F2		FUSE: instantaneous, glass cartridge, 3 amp, 250 V Pan Part F-2009	AT F-2009		
J3		CONNECTOR: receptacle, 5 pin, male contacts Pan Part J-2013	AB AN3102A-14S-5P	1	
J5		JACK: tip, black Pan Part J-2001	AD 407	1	
J7		CONNECTOR: receptacle, 14 pin, female contacts Pan Part J2008	AB AN3102A-28-2S	1	
P1		CONNECTOR: plug, electric, 3 wire, AC power, twistlock type Pan Part P2053	BF 7485	1	
R1		RESISTOR: fixed, composition, 330,000 ohms, ±10%, 1 W Pan Part RC32BX334K	AA GB3341	2	
R3		RESISTOR: fixed, composition, 330,000 ohms, ±10%, 1 W Pan Part RC32BX334K	AA GB3341		
R5		RESISTOR: fixed, composition, 10 megohms, ±5%, 1/2 W Pan Part RC20BX106J	AA EB1065	1	
R7		RESISTOR: fixed, composition, 120 ohms, ±5%, 1/2 W Pan Part RC20BX121J	AA EB1215	2	
R9		RESISTOR: fixed, composition, 120 ohms, ±5%, 1/2 W Pan Part RC20BX121J	AA EB1215		
R11		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025	2	
R13		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		

List of Replaceable Parts for Power Supply, Model PS-19 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R15		RESISTOR: fixed, composition, 8.2 megohms, ±5%, 1/2 W Pan Part RC20BX825J	AA EB8255	1	
R17		RESISTOR: fixed, composition, 3 megohms, ±5%, 1/2 W Pan Part RC20BX305J	AA EB3055	4	
R19		RESISTOR: fixed, composition, 3 megohms, ±5%, 1/2 W Pan Part RC20BX305J	AA EB3055		
R21		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W Pan Part RC20BX244J	AA EB2445	2	
R23		RESISTOR: fixed, composition, 3 megohms, ±5%, 1/2 W Pan Part RC20BX305J	AA EB3055		
R25		RESISTOR: fixed, composition, 3 megohms, ±5%, 1/2 W Pan Part RC20BX305J	AA EB3055		
R27		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045	1	
R29		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055	2	
R31		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055		
R33		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W Pan Part RC20BX244J	AA EB2445		
R35		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1/2 W Pan Part RC20BX683J	AA EB6835	1	
R37		RESISTOR: fixed, composition, 330,000 ohms, ±5%, 1/2 W Pan Part RC20BX334J	AA EB3345	1	
R39		RESISTOR: variable, composition, linear, 50,000 ohms, ±10%, 2 W Pan Part RV014	AT RV2-22014	1	
R41		RESISTOR: fixed, composition, 56,000 ohms, ±5%, 1/2 W Pan Part RC20BX563J	AA EB5635	1	

List of Replaceable Parts for Power Supply, Model PS-19 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R43		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045	3	
R45		RESISTOR: fixed, composition, 100 ohms, ±5%, 1 W Pan Part RC32BX101J	AA GB1015	1	
R47		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1 W Pan Part RC32BX333J	AA GB3335	1	
R49		RESISTOR: fixed, composition, 30,000 ohms, ±5%, 1 W Pan Part RC32BX303J	AA GB3035	1	
R51		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045		
R53		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AA HB1065	4	
R55		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AA HB1065		
R57		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045		
R59		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AA HB1065		
R61		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AA HB1065		
T1		TRANSFORMER: power, low voltage, Primary: 115 V, 50-60 cps, Secondary: 880 VCT, 200 ma dc; 5.0 V, 3.0 amp; 6.3 V, 3.0 amp; 6.3 V, 1.2 amp; 6.3 V, 6.0 amp Pan Part T3-10791B	AT T3-10791B	1	
T2		TRANSFORMER: power, high voltage, Primary: 115V/230 V, 50-60 cps, Secondary: 1200 V, 4 ma; 6.4 V, 0.6 amp; 6.3 V, 6 amp Pan Part T3-9875D	AT T3-9875D	1	

List of Replaceable Parts for Power Supply, Model PS-19 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
V1		ELECTRON TUBE: 5U4GB Pan Part 5U4GB	BA 5U4GB	1	
V2		ELECTRON TUBE: 6146 Pan Part 6146	BA 6146	2	
V3		ELECTRON TUBE: 6146 Pan Part 6146	BA 6146		
V4		ELECTRON TUBE: 12AX7 Pan Part 12AX7	BA 12AX7	2	
V5		ELECTRON TUBE: 12AX7 Pan Part 12AX7	BA 12AX7		
V6		ELECTRON TUBE: 5651 Pan Part 5651	BA 5651	2	
V7		ELECTRON TUBE: 5651 Pan Part 5651	BA 5651		

MANUFACTURERS CODE FOR
LIST OF REPLACEABLE PARTS

AA	Allen-Bradley Company
AB	Amphenol Electronics Corporation
AC	Arrow-Hart & Hegeman Electric Company
AD	Birnbach Radio Company
AE	Cardwell Condenser Corporation
AF	Centralab Division of Globe-Union, Inc.
AG	Clarostat Manufacturing Company, Inc.
AH	Continental Carbon, Inc.
AJ	Cornell-Dubilier Electric Corporation
AK	E. F. Johnson Company
AL	Electro Motive Manufacturing Company
AM	Erie Resistor Corporation
AN	Stackpole Division, G-C Electronics Mfg. Company
AO	General Electric Company
AP	Gudeman Manufacturing Company
AQ	International Resistance Company
AR	J. F. D. Electronics
AS	J. W. Miller Company
AT	Panoramic Electronics, Inc.
AU	Radio Receptor, Inc.
AV	Sangamo Electric Company
AW	Sprague Electric Company
AX	Tele Radio Engineering Corporation
AY	Tru-Ohm Products Division, Model Eng. & Mfg., Inc.
AZ	Vari-L Corporation
BA	Any E. I. A. Manufacturer
BB	Wilco Corporation
BC	Dialight Corporation
BD	Kidco Inc.
BE	Winchester Electronics, Inc.
BF	Hubbell, Harvey, Inc.
BG	Sola Electric Company
BH	Sealectro Corporation
BI	Aladdin Industries Inc.
BJ	Radio Corporation of America

REPAIR AND MAINTENANCE FORM

COMPANY

DATE

ATTENTION

PHONE

INSTRUMENT DATA

MODEL

TYPE

SERIAL NUMBERS: ANALYZER

POWER SUPPLY

ACCESSORIES

(IF THE FRONT PANEL SERIAL NUMBER DIFFERS FROM THE SERIAL NUMBER ON THE PATENT LABEL ON THE REAR OF THE CHASSIS, PLEASE LIST PATENT LABEL SERIAL NUMBER)

REPAIR DATA

1. TYPE OF TROUBLE*

2. TEST INSTRUMENTS USED FOR MAINTENANCE AND TROUBLE SHOOTING

3. APPROXIMATE DATE INSTRUMENT PLACED IN OPERATION

4. APPROXIMATE NUMBER OF HOURS INSTRUMENT IN OPERATION SINCE ITEM 3

*Please include information on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

SINGER METRICS
DIVISION

5. HAS MAINTENANCE ACTION PREVIOUSLY BEEN REQUESTED? ______________________________

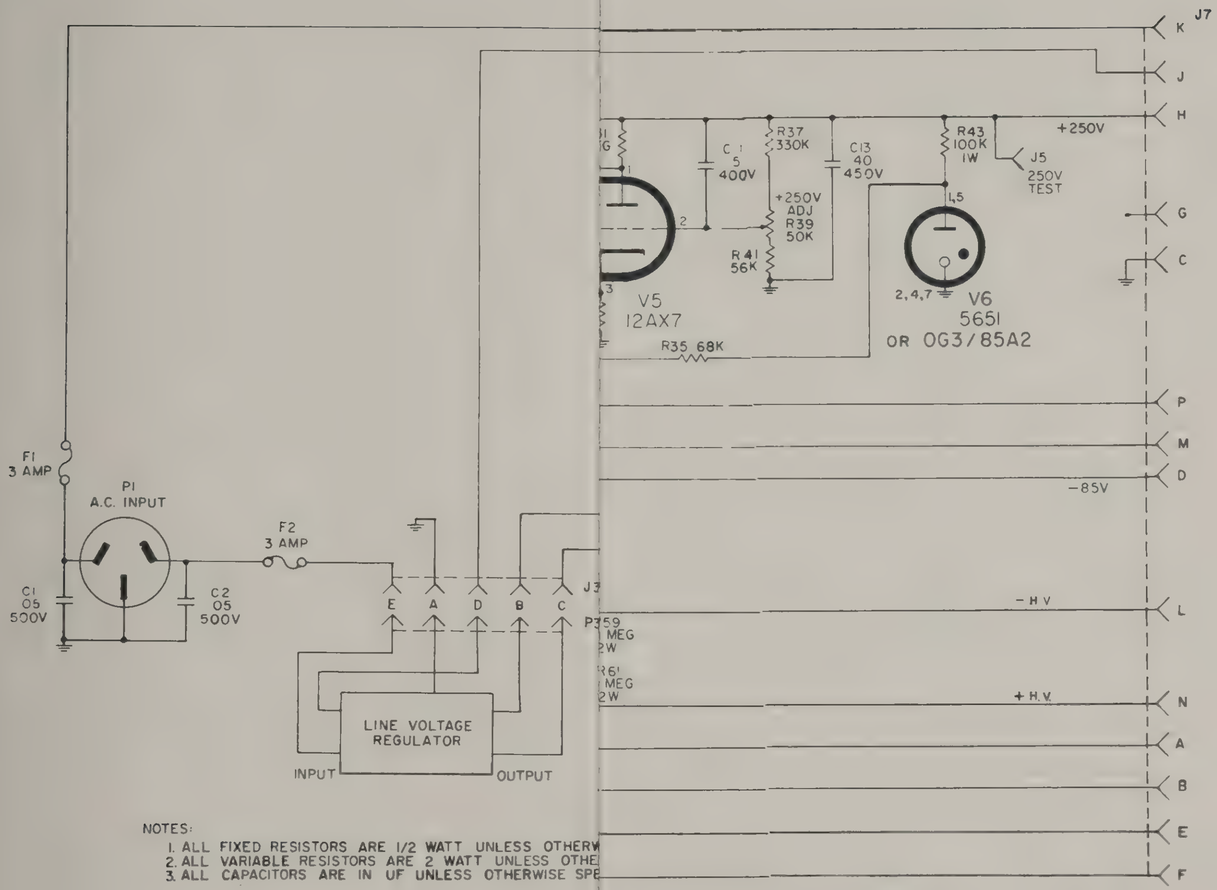
6. RESULTS? ______________________________

7. COMMENTS:

For repair or maintenance assistance, fill out this form as completely as possible and send to:

SERVICE DEPARTMENT 540
SINGER METRICS DIVISION
THE SINGER MANUFACTURING CO.
915 PEMBROKE AVENUE
BRIDGEPORT 8, CONNECTICUT

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.


J7
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R37
330K
C 1
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400V
C13
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450V
R43
100K
1W
J5
250V
TEST
+250V
ADJ
R39
50K
R41
56K
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2
3
1,5
V5
12AX7
V6
5651
OR 0G3/85A2
2,4,7
R35 68K
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F1
3 AMP
P1
A.C. INPUT
F2
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R61
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LINE VOLTAGE
REGULATOR
INPUT
OUTPUT

NOTES:
1. ALL FIXED RESISTORS ARE 1/2 WATT UNLESS OTHERW
2. ALL VARIABLE RESISTORS ARE 2 WATT UNLESS OTHE
3. ALL CAPACITORS ARE IN UF UNLESS OTHERWISE SPE

PS-19 POWER SUPPLY 02-556155-168

5. HAS MAINTENANCE ACTION PREVIOUSLY BEEN REQUESTED? ____________________

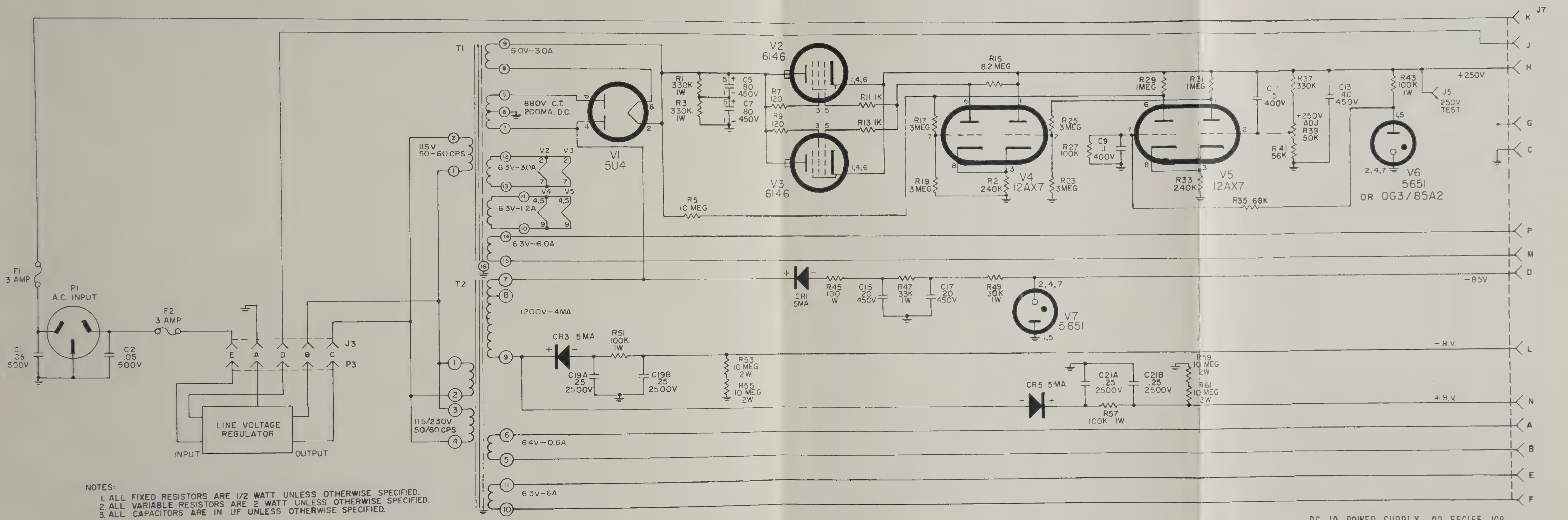
6. RESULTS? ____________________

7. COMMENTS:

For repair or maintenance assistance, fill out this form as completely as possible and send to:

SERVICE DEPARTMENT 540
SINGER METRICS DIVISION
THE SINGER MANUFACTURING CO.
915 PEMBROKE AVENUE
BRIDGEPORT 8, CONNECTICUT

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.


J7
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T1
9
5.0V-3.0A
8
5
880V C.T.
200MA. D.C.
6
7
115V
50-60 CPS
2
1
12
6.3V-3.0A
13
V2
V3
11
6.3V-1.2A
10
V4
V5
4,5
9
14
6.3V-6.0A
15
16
V1
5U4
R1
330K
1W
R3
330K
1W
C5
80
450V
C7
80
450V
V2
6146
V3
6146
R7
120
R9
120
1,4,6
3 5
R11 1K
R13 1K
R5
10 MEG
R15
8.2 MEG
R17
3MEG
R19
3MEG
R21
240K
V4
12AX7
R25
3MEG
R27
100K
R23
3MEG
C9
.1
400V
R29
1MEG
R31
1MEG
V5
12AX7
R33
240K
R35 68K
C11
5
400V
R37
330K
+250V
ADJ
R39
50K
R41
56K
C13
40
450V
R43
100K
1W
J5
250V
TEST
1,5
2,4,7
V6
5651
OR 0G3/85A2
F1
3 AMP
P1
A.C. INPUT
C1
.05
500V
C2
.05
500V
F2
3 AMP
E
A
D
B
C
J3
P3
LINE VOLTAGE
REGULATOR
INPUT
OUTPUT
T2
7
8
1200V-4MA
9
1
2
3
4
115/230V
50/60 CPS
CR1
5MA
R45
100
1W
C15
20
450V
R47
33K
1W
C17
20
450V
R49
30K
1W
2,4,7
V7
5651
1,5
CR3 5MA
R51
100K
1W
C19A
.25
2500V
C19B
.25
2500V
R53
10 MEG
2W
R55
10 MEG
2W
CR5 5MA
C21A
.25
2500V
C21B
.25
2500V
R57
100K 1W
R59
10 MEG
2W
R61
10 MEG
2W
6
64V-0.6A
5
11
6.3V-6A
10

NOTES:
1. ALL FIXED RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.
2. ALL VARIABLE RESISTORS ARE 2 WATT UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITORS ARE IN UF UNLESS OTHERWISE SPECIFIED.

PS-19 POWER SUPPLY 02-556155-168

05
9K
W5
L.1
29.3
197
.7
P1
P1
431
5K
XT

)R GREATER ARE IN UUF.

5 THAN 1 ARE IN UF.

2 W UNLESS OTHERWISE SPECIFIED.

2 W UNLESS OTHERWISE SPECIFIED.

TED ON THE FRONT PANEL.

FROM END OPPOSITE THE CONTROL KNOB

EWED FROM THE CONTROL KNOB END.

WAFER.

FER.

MPONENTS.

T COMPONENTS FOR 50Ω SET.

/ISION ~~NAME~~ REVISED EBL 11-30-63 H. Lee
ARKED PRINT CO 6203

EVISED PER CO 6034 HG 10-2-63 HE

DED S/N & C116 PER C05498 P.H. 3-29-63 JDH 3-29-63

DRAWN FROM P5-15199L WITH CHANGES AS PER C05362 & C05477 P.H. 1-28-63

ON	DRAFTSMAN	P.H	1-28-63
3/	CHECKER	J.F	1-28-63
C	ORIGINATOR		
	ENG.		

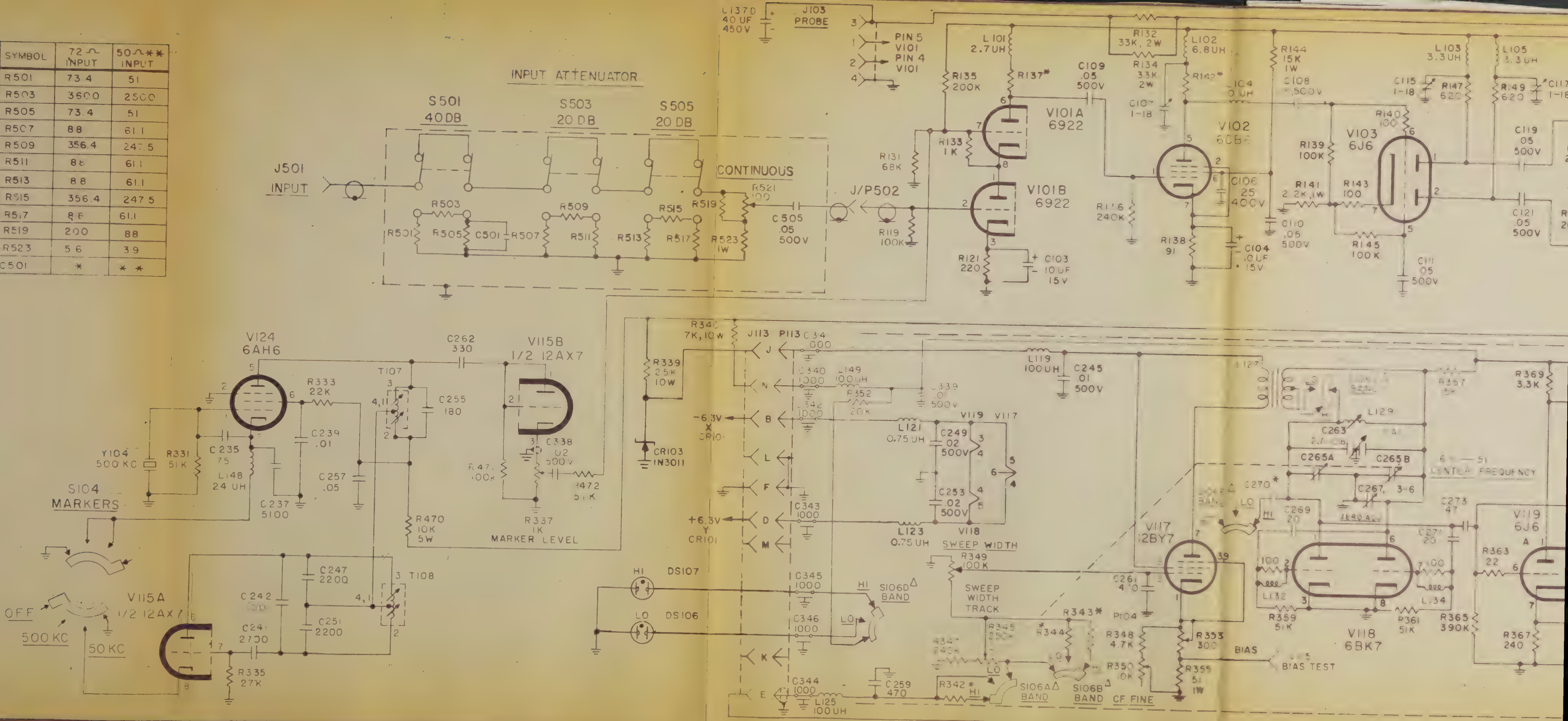
SINGER METRICS

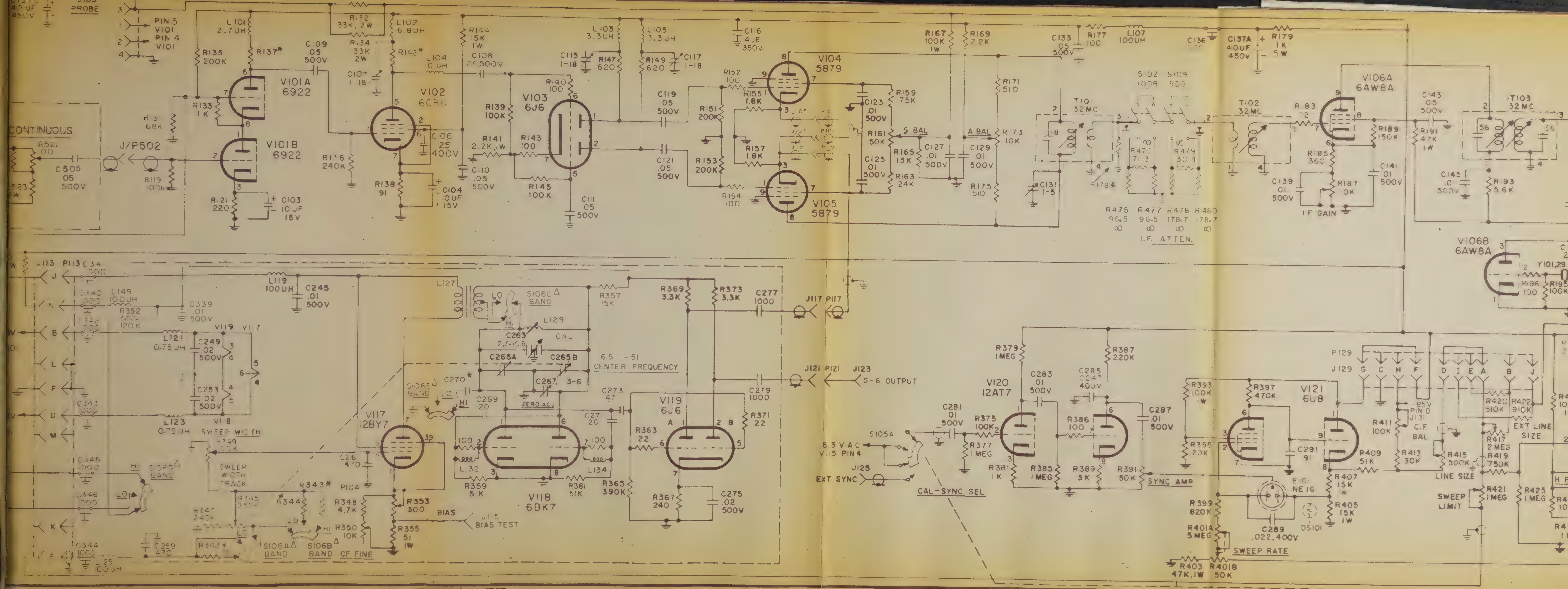
SPA-3/25aMC ANALYZER

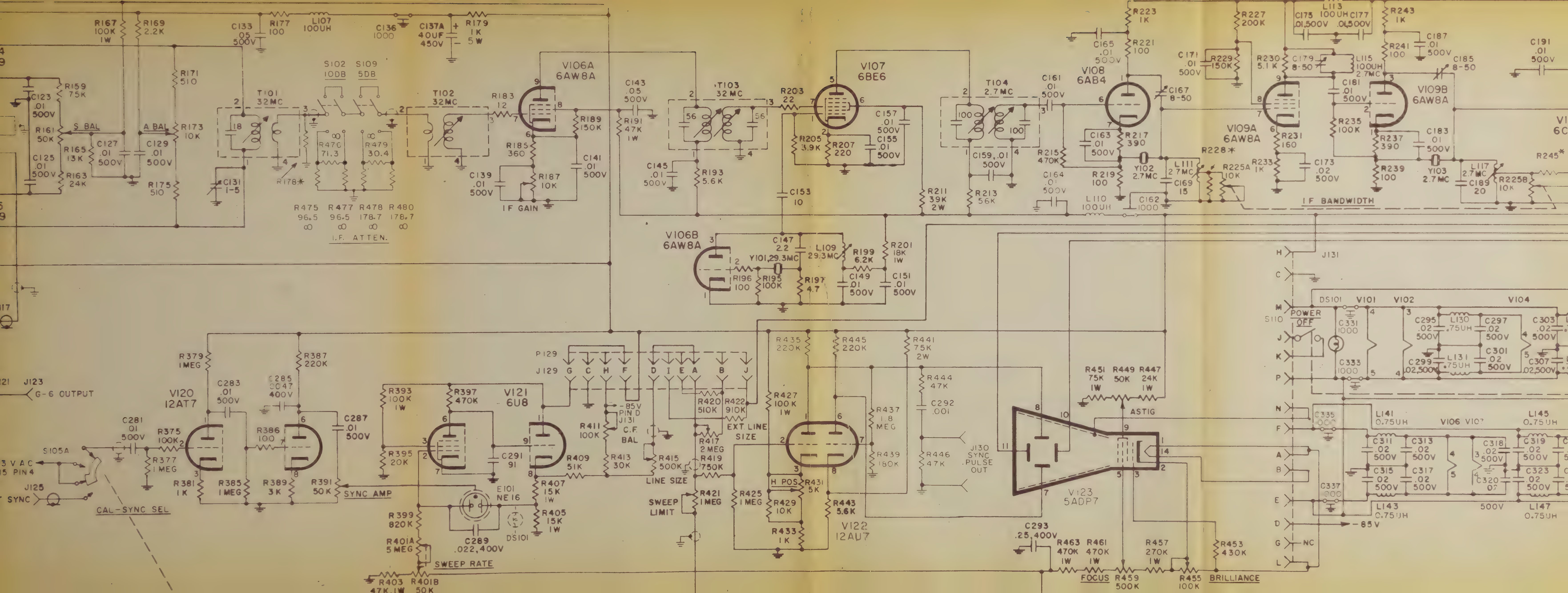
DWG. NO. 556155-199

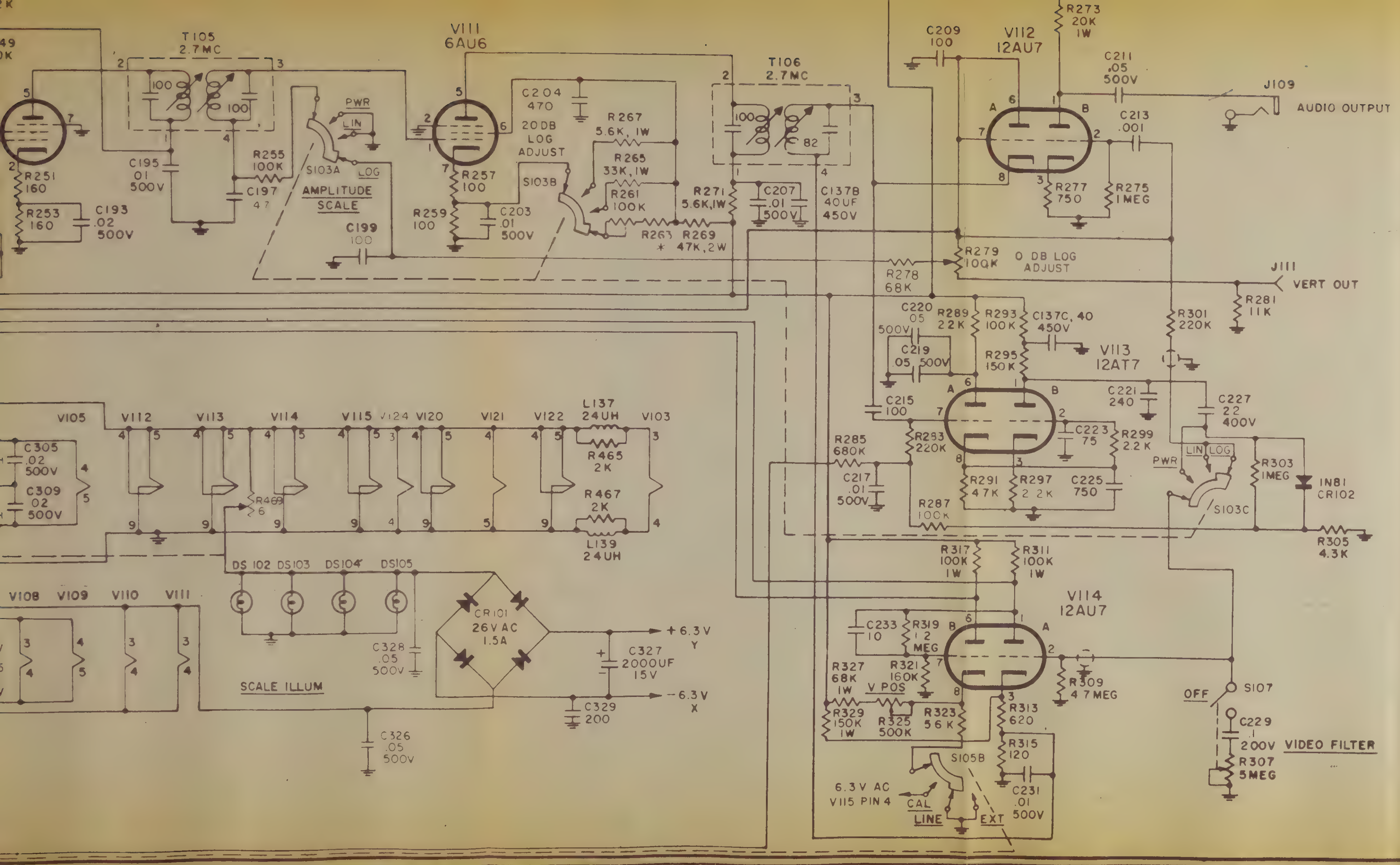
REV. 14

SYMBOL	72 Ω INPUT	50 Ω ** INPUT
R501	73 4	51
R503	3600	2500
R505	73.4	51
R507	88	61.1
R509	356.4	247.5
R511	88	61.1
R513	88	61.1
R515	356.4	247 5
R517	88	61.1
R519	200	88
R523	5 6	3 9
C501	*	* *


INPUT ATTENUATOR
S501 40 DB
S503 20 DB
S505 20 DB
J501 INPUT
R503
R509
R515
R519
R501
R505
C501
R507
R511
R513
R517
R523 1W
CONTINUOUS
R521 100
C505 .05 500V
J/P502
R119 100K
C137 D 40 UF 450V
J103 PROBE
PIN 5 V101
PIN 4 V101
L101 2.7UH
R135 200K
R137*
C109 .05 500V
R132 33K, 2W
R134 33K 2W
L102 6.8UH
R142*
L104
C107 1-18
R144 15K 1W
C108
L103 3.3UH
L105 3.3UH
C115 1-18
R147 620
R149 620
C117 1-18
V101A 6922
V101B 6922
R131 68K
R133 1K
R121 220
C103 10 UF 15V
V102 6CB6
C106 25 400V
R116 240K
R138 91
C104 10 UF 15V
R139 100K
R140 100
V103 6J6
R141 2.2K 1W
R143 100
C110 .05 500V
R145 100K
C111 .05 500V
C119 .05 500V
C121 .05 500V
V124 6AH6
C262 330
V115B 1/2 12AX7
R333 22K
T107
C255 180
C239 .01
C235 75
L148 24 UH
Y104 500 KC
R331 51K
C257 .05
C237 5100
C338 .02 500V
R471 100K
R472 51K
R337 1K MARKER LEVEL
R470 10K 5W
S104 MARKERS
OFF
500 KC
50 KC
V115A 1/2 12AX7
C242
C247 2200
C251 2200
C241 2700
T108
R335 27K
R340 7K, 10W
R339 2.5K 10W
CR103 1N3011
J113
P113
C341 1000
C340 1000
L149 100 UH
R352 20K
C339 .01 500V
C342 1000
L119 100 UH
C245 .01 500V
-6.3V X CR101
+6.3V Y CR101
L121 0.75 UH
C249 .02 500V
V119
V117
C253 .02 500V
L123 0.75 UH
V118
SWEEP WIDTH
C343 1000
R349 100K
SWEEP WIDTH TRACK
C345 1000
C346 1000
C344 1000
L125 100 UH
C259 470
HI DS107
LO DS106
S106D BAND
HI
LO
R343*
R344*
R342*
S106A BAND
S106B BAND
CF FINE
R348 4.7K
R350 10K
R353 300
R355 51 1W
BIAS
BIAS TEST
P104
C261 470
V117 12BY7
L127
R357
L129
C263
C265A
C265B
CENTER FREQUENCY
C270*
C267 3-6
C269 20
C273 47
V118 6BK7
R359 51K
R361 51K
L132
L134
R365 390K
R369 3.3K
V119 6J6
R363 22
R367 240
J K L M N B F D E


PROBE
PIN 5 V101
PIN 4 V101
L101 2.7UH
R135 200K
R137*
R133 1K
V101A 6922
V101B 6922
CONTINUOUS
R521 100
C505 .05 500V
J/P502
R119 100K
R121 220
C103 10UF 15V
C109 .05 500V
R132 33K, 2W
R134 33K 2W
L102 6.8UH
R142*
C107 1-18
L104 10 UH
C108 CF,500V
V102 6CB6
C106 25 400V
R136 240K
R138 91
C104 10UF 15V
R144 15K 1W
R139 100K
R141 2.2K,1W
C110 .05 500V
V103 6J6
R140 100
R143 100
R145 100K
C111 .05 500V
L103 3.3UH
C115 1-18
R147 620
L105 3.3UH
R149 620
C117 1-18
C116 4UF 350V.
C119 .05 500V
C121 .05 500V
R152 100
R151 200K
R155 1.8K
R157 1.8K
R153 200K
R154 100
V104 5879
V105 5879
J105 P105
J107 P107
J109 P109
C123 .01 500V
R159 75K
R161 50K
S BAL
R165 13K
R163 24K
C125 .01 500V
R167 100K 1W
R169 2.2K
C127 .01 500V
A BAL
R171 510
R173 10K
C129 .01 500V
R175 510
C133 .05 500V
R177 100
L107 100UH
C136
C137A 40UF 450V
R179 1K 5W
T101 32MC
C131 1-5
R178*
S102 10DB
S109 5DB
R470 71.3
R479 30.4
R475 96.5
R477 96.5
R478 178.7
R480 178.7
I.F. ATTEN.
T102 32MC
R183 12
V106A 6AW8A
R185 360
R187 10K
I F GAIN
C139 .01 500V
R189 150K
C141 .01 500V
C143 .05 500V
R191 47K 1W
C145 .01 500V
R193 5.6K
T103 32MC
V106B 6AW8A
Y101,29
R196 100
R195 100K
J113 P113
C334 .500
C340 .500
L149 100UH
R352 120K
C339 .01 500V
C342 .500
L119 100UH
C245 .01 500V
L121 0.75UH
C249 .02 500V
V119 V117
C253 .02 500V
L123 0.75UH
V118
SWEEP WIDTH
R349 50K
SWEEP WIDTH TRACK
C343 1000
C345 1000
C346 1000
S106D BAND
HI LO
C344 1000
L125 100UH
C259 470
R342
R347 240
R345 250
R344
R343*
S106A BAND
S106B BAND
CF FINE
L127
S106C BAND
L129
C263 2.7-10.8
CAL
C265A
C265B
6.5 — 51 CENTER FREQUENCY
C267, 3-6
ZERO ADJ
S106E BAND
C270*
C269 20
C261 470
V117 12BY7
P104
R348 4.7K
R350 10K
R353 300
R355 51 1W
BIAS
J115 BIAS TEST
L132
L134
R359 51K
R361 51K
V118 6BK7
C271 20
C273 47
R357 15K
R369 3.3K
R373 3.3K
C277 1000
J117 P117
V119 6J6
R363 22
R371 22
R365 390K
R367 240
C275 .02 500V
C279 1000
J121 P121
J123 G-6 OUTPUT
S105A
6.3 VAC V115 PIN 4
J125
EXT SYNC
CAL-SYNC SEL
C281 .01 500V
R375 100K
R377 1MEG
V120 12AT7
R379 1MEG
C283 .01 500V
C285 .0047 400V
R387 220K
R386 100
R381 1K
R385 1MEG
R389 3K
R391 50K
SYNC AMP
C287 .01 500V
R393 100K 1W
R397 470K
R395 20K
V121 6U8
C291 91
R399 820K
R401A 5MEG
E101 NE16
DS101
C289 .022,400V
SWEEP RATE
R403 47K,1W
R401B 50K
R407 15K 1W
R405 15K 1W
R409 51K
R411 100K
-85V PIN D J131
C.F. BAL
R413 30K
R415 500K
LINE SIZE
P129
J129
G C H F D I E A B J
R420 510K
R422 910K
EXT LINE SIZE
R417 2MEG
R419 750K
R421 1MEG
SWEEP LIMIT
R425 1MEG


R167 100K 1W
R169 2.2K
C133 .05 500V
R177 100
L107 100UH
C136 1000
C137A 40UF 450V
R179 1K 5W
R159 75K
C123 .01 500V
R171 510
R161 50K
S BAL
A BAL
R173 10K
C127 .01 500V
C129 .01 500V
R165 13K
C125 .01 500V
R163 24K
R175 510
T101 32MC
S102 10DB
S109 5DB
T102 32MC
R178*
C131 1-5
R470 71.3
R479 30.4
R475 96.5
R477 96.5
R478 178.7
R480 178.7
I.F. ATTEN.
V106A 6AW8A
R183 12
R189 150K
R185 360
R187 10K
C139 .01 500V
C141 .01 500V
I F GAIN
C143 .05 500V
R191 47K 1W
T103 32MC
C145 .01 500V
R193 5.6K
R203 22
V107 6BE6
R205 3.9K
R207 220
C155 .01 500V
C157 .01 500V
C153 10
R211 39K 2W
T104 2.7MC
C159 .01 500V
R213 56K
C161 .01 500V
R215 470K
C164 .01 500V
L110 100UH
C162 1000
V108 6AB4
C165 .01 500V
R223 1K
R221 100
C163 .01 500V
R217 390
C167 8-50
R219 100
Y102 2.7MC
L111 2.7MC
C169 15
R225A 10K
R228*
V109A 6AW8A
C171 .01 500V
R229 150K
R227 200K
R230 5.1K
C179 8-50
L113 100UH
C175 .01 500V
C177 .01 500V
L115 100UH 2.7MC
R243 1K
C187 .01 500V
R241 100
C181 .01 500V
R235 100K
R231 160
R233 1K
C173 .02 500V
V109B 6AW8A
C185 8-50
R237 390
C183 .01 500V
R239 100
Y103 2.7MC
L117 2.7MC
C189 20
R225B 10K
I F BANDWIDTH
C191 .01 500V
R245*
V106B 6AW8A
C147 2.2
Y101 29.3MC
L109 29.3MC
R199 6.2K
R201 18K 1W
R196 100
R195 100K
R197 4.7
C149 .01 500V
C151 .01 500V
J131
H C M S110 POWER OFF J K P N F A B E D G L
DS101 V101 V102 V104
C331 1000
C333 1000
C295 .02 500V
L130 .75UH
C297 .02 500V
C301 .02 500V
C299 .02 500V
L131 .75UH
C303 .02 500V
C307 .02 500V
C335 1000
L141 0.75UH
V106 V107
L145 0.75UH
C311 .02 500V
C313 .02 500V
C318 .02 500V
C319 .02 500V
C315 .02 500V
C317 .02 500V
C320 .02
C323 .02 500V
C337 1000
L143 0.75UH
500V
L147 0.75UH
-85V
NC
J121 J123
G-6 OUTPUT
R379 1MEG
C283 .01 500V
R387 220K
C285 .0047 400V
V120 12AT7
C281 .01 500V
R375 100K
R377 1MEG
R386 100
C287 .01 500V
S105A
3 VAC 5 PIN 4
J125
SYNC
R381 1K
R385 1MEG
R389 3K
R391 50K
SYNC AMP
CAL-SYNC SEL
P129
J129 G C H F D I E A B J
R393 100K 1W
R397 470K
V121 6U8
R395 20K
C291 91
R409 51K
R407 15K 1W
R405 15K 1W
E101 NE16
DS101
C289 .022, 400V
R399 820K
R401A 5MEG
SWEEP RATE
R403 47K 1W
R401B 50K
-85V PIN D J131
R411 100K
C.F. BAL
R413 30K
R420 510K
R422 910K
EXT LINE SIZE
R417 2MEG
R419 750K
R415 500K
LINE SIZE
R421 1MEG
SWEEP LIMIT
R435 220K
R445 220K
R441 75K 2W
R427 100K 1W
R437 1.8 MEG
R439 180K
R444 47K
C292 .001
R446 47K
J130 SYNC PULSE OUT
V122 12AU7
R425 1MEG
H POS
R431 5K
R429 10K
R433 1K
R443 5.6K
R451 75K 1W
R449 50K
R447 24K 1W
ASTIG
V123 5ADP7
C293 .25, 400V
R463 470K 1W
R461 470K 1W
FOCUS
R459 500K
R457 270K 1W
R455 100K
BRILLIANCE
R453 430K


T105
2.7MC
V111
6AU6
T106
2.7MC
C209
100
V112
12AU7
R273
20K
1W
C211
.05
500V
J109
AUDIO OUTPUT
C213
.001
R251
160
R253
160
C193
.02
500V
C195
.01
500V
R255
100K
C197
47
PWR
LIN
LOG
S103A
AMPLITUDE SCALE
C199
100
C204
470
20 DB LOG ADJUST
R267
5.6K, 1W
R265
33K, 1W
R261
100K
R257
100
R259
100
C203
.01
500V
S103B
R263
* 47K, 2W
R269
R271
5.6K, 1W
C207
.01
500V
C137B
40UF
450V
R277
750
R275
1MEG
R279
100K
0 DB LOG ADJUST
R278
68K
J111
VERT OUT
R281
11K
C220
.05
500V
R289
2.2K
R293
100K
C137C, 40
450V
V113
12AT7
R301
220K
C219
.05
500V
R295
150K
C215
100
C221
240
C227
22
400V
R285
680K
R283
220K
C223
75
R299
2.2K
C217
.01
500V
R291
47K
R297
2.2K
C225
750
R287
100K
PWR
LIN LOG
S103C
R303
1MEG
1N81
CR102
R305
4.3K
V105
V112
V113
V114
V115
V124
V120
V121
V122
L137
24UH
V103
C305
.02
500V
C309
.02
500V
R465
2K
R467
2K
R469
L139
24UH
DS 102
DS103
DS104
DS105
R317
100K
1W
R311
100K
1W
V114
12AU7
V108
V109
V110
V111
CR101
26V AC
1.5A
+6.3V
Y
C327
2000UF
15V
C328
.05
500V
-6.3V
X
C329
200
SCALE ILLUM
C326
.05
500V
C233
10
R319
1.2
MEG
R327
68K
1W
R321
160K
V POS
R329
150K
1W
R325
500K
R323
56K
R309
4.7MEG
R313
620
R315
120
C231
.01
500V
S105B
6.3V AC
V115 PIN 4
CAL
LINE
EXT
OFF
S107
C229
1
200V
VIDEO FILTER
R307
5MEG

NOTES:

1. UNLESS OTHERWISE SPECIFIED
   ALL CAPACITANCE VALUES 1 OR GREATER ARE IN UUF.
   ALL CAPACITANCE VALUES LESS THAN 1 ARE IN UF.
2. ALL FIXED RESISTORS ARE 1/2 W UNLESS OTHERWISE SPECIFIED.
3. ALL VARIABLE RESISTORS ARE 2 W UNLESS OTHERWISE SPECIFIED.
4. UNDERLINED TITLES ARE LOCATED ON THE FRONT PANEL.
5. ROTARY SWITCHES ARE VIEWED FROM END OPPOSITE THE CONTROL KNOB EXCEPT FOR S101 WHICH IS VIEWED FROM THE CONTROL KNOB END.
6. △S106A,B,C, ARE ON FRONT OF WAFER.
   S106D,E, ARE ON REAR OF WAFER.
7. *DENOTES FACTORY ADJUST COMPONENTS.
8. ** DENOTES FACTORY ADJUST COMPONENTS FOR 50Ω SET.

FACTORY ADJUST COMPONENTS		
REFERENCE SYMBOL	NOMINAL VALUE	VALUE USED
R342	47K	
R344	180K	
R343	120K	
R137	560	
R142	1K	
R228	——	
R245	——	
C270	10	
R263	15K, 1W	
C501	65	
R178	120	

NO REVISION CHANGE REVISED PER MARKED PRINT CO 6203	EBL 11-30-63
14	REVISED PER CO 6034 HG 10-2-63
13	ADDED S/N & C116 PER CO5498 P.H. 3-29-63
M	REDRAWN FROM P5-15199L WITH CHANGES AS PER CO5362 & CO5477, P.H.

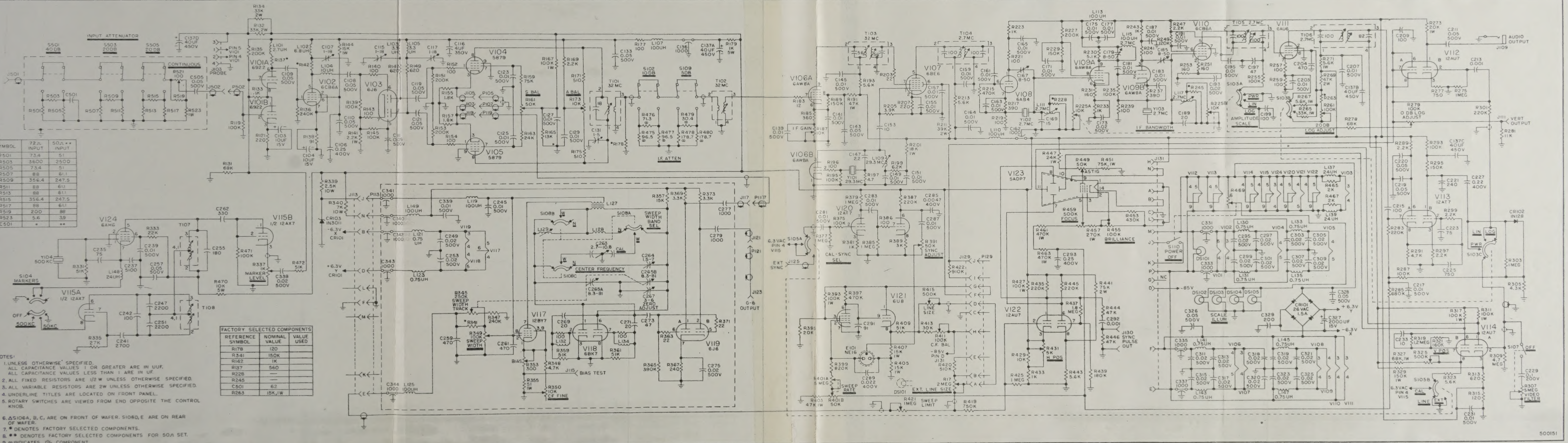
USED ON	DRAFTSMAN	P.H.	1-28-63
SPA-3/ 25aMC	CHECKER	J.F.	1-28-63
	ORIGINATOR		
	ENG.		

SINGER METRICS

SPA-3/25aMC ANALYZER

DWG. NO. 556155-199

REV. 14


INPUT ATTENUATOR
S501 40DB
S503 20DB
S505 20DB
CONTINUOUS
J501
J502
P502
J103 PROBE
V101A 6922
V101B 6922
V102 6CB6A
V103 6J6
V104 5879
V105 5879
S BAL
A BAL
T101 32MC
S102 10DB
S109 5DB
T102 32MC
IF ATTEN
T103 32MC
T104 2.7MC
V106A 6AW8A
V106B 6AW8A
I.F. GAIN
V107 6BE6
V108 6AB4
V109A 6AW8A
V109B 6AW8A
I.F. BANDWIDTH
V110 6CB6A
T105 2.7MC
V111 6AU6
T106 2.7MC
AMPLITUDE SCALE
LIN
LOG
PWR
LOG ADJUST
V112 12AU7
J109 AUDIO OUTPUT
J111 VERT OUTPUT
0 DB LOG ADJUST
V113 12AT7
V123 5ADP7
ASTIG
FOCUS
BRILLIANCE
V124 6AH6
V115B 1/2 12AX7
V115A 1/2 12AX7
T107
T108
S104 MARKERS
OFF 500KC 50KC
MARKER LEVEL
Y104 500KC
V117 12BY7
V118 6BK7
V119 6J6
SWEEP WIDTH TRACK
SWEEP WIDTH
SWEEP WIDTH BAND SEL
CENTER FREQUENCY
ZERO ADJUST
BIAS TEST
CF FINE
J123 G-G OUTPUT
V120 12AT7
CAL-SYNC SEL
SYNC ADJUST
EXT SYNC
V121 6U8
LINE SIZE
C.F. BAL
SWEEP RATE
EXT. LINE SIZE
SWEEP LIMIT
E101 NE16
DS101
V122 12AU7
H POS
J130 SYNC PULSE OUT
S110 POWER OFF
SCALE ILLUM
V114 12AU7
V POS
S107 OFF
CAL
LINE EXT
VIDEO FILTER
J102 IN128

SYMBOL	72Ω INPUT	50Ω ** INPUT
R501	73.4	51
R503	3600	2500
R505	73.4	51
R507	88	61.1
R509	356.4	247.5
R511	88	61.1
R513	88	61.1
R515	356.4	247.5
R517	88	61.1
R519	200	88
R523	5.6	3.9
C501	*	**

NOTES:

1. UNLESS OTHERWISE SPECIFIED.
   ALL CAPACITANCE VALUES 1 OR GREATER ARE IN UUF.
   ALL CAPACITANCE VALUES LESS THAN 1 ARE IN UF.
2. ALL FIXED RESISTORS ARE 1/2 W UNLESS OTHERWISE SPECIFIED.
3. ALL VARIABLE RESISTORS ARE 2W UNLESS OTHERWISE SPECIFIED.
4. UNDERLINE TITLES ARE LOCATED ON FRONT PANEL.
5. ROTARY SWITCHES ARE VIEWED FROM END OPPOSITE THE CONTROL KNOB.
6. ΔS106A, B, C, ARE ON FRONT OF WAFER. S106D, E ARE ON REAR OF WAFER.
7. * DENOTES FACTORY SELECTED COMPONENTS.
8. ** DENOTES FACTORY SELECTED COMPONENTS FOR 50Ω SET.
9. ∞ INDICATES 1% COMPONENT.

FACTORY SELECTED COMPONENTS		
REFERENCE SYMBOL	NOMINAL VALUE	VALUE USED
R178	120	
R341	150K	
R142	1K	
R137	560	
R228	—	
R245	—	
C501	62	
R263	15K, 1W	

500151

Spectrum Analyzer, Model SPA-3a, Schematic Diagram